

The Kalamazoo River: Beauty and the Beast

***Remedial and Preventive Action Plan
for the Kalamazoo River Watershed Area of Concern***

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From the Public Advisory Council and the residents of the Kalamazoo River watershed thanks to all who participated in this process.

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A Message from the Kalamazoo River Public Advisory Council

The Kalamazoo River Public Advisory Council (PAC) is a group of local citizens representing a variety of stakeholders throughout the Area of Concern (AOC): business people, agricultural interests, landowners, hunting/fishing groups, local governmental units, public health agencies, educators, conservationists, and environmental activists. The PAC was established in May 1993 to assist and advise the Michigan Department of Environmental Quality (MDEQ) Remedial Action Plan (RAP) team with the development of the RAP, a plan to restore and protect the Kalamazoo River. PAC members are liaisons between the public and the RAP process. Additionally, PAC subcommittees develop strategies to enhance communication, public relations, and project funding. Activities have included a guided bus tour of the AOC for elected officials and others, development of a brochure describing the RAP and PAC, placing of fishing advisory/information signs at access sites, development of the RAP as presented in this document, cosponsorship of a Coastal Wetland Conference, hosting presentations by resource experts at PAC meetings, hosting a meeting with relevant Superfund industrial and agency representatives, developing and obtaining wide-spread endorsement of a *Position Statement on the Clean-up and Protection of the Kalamazoo River*, and cosponsoring a Physician's Symposium on environmental contaminants. Other focus areas include the Rabbit River (a major tributary), nonpoint source pollution abatement, resource education, reuse of contaminated sites, and strategic land use planning/zoning. The PAC has recently taken steps to incorporate and obtain non-profit status. The PAC meets ten times each year. Everyone is encouraged to attend and to become involved in PAC activities.

The PAC mission statement says that the "Council is to work for the continued improvement and protection of the Kalamazoo River through the wise balance and management of human, economic, and ecological resources. To that end, we seek to work with all parties in a committed, cooperative manner for the improvement of the quality of life within the Kalamazoo River Watershed."

This booklet is a description and evaluation of the River system, and presents recommendations for the restoration of the AOC.

The Public Advisory Council is pleased to provide this document to those interested in the Kalamazoo River. Additional copies can be obtained from the PAC office (616-324-1600), or by contacting the MDEQ Surface Water Quality Division in Lansing (517-241-7734 or 517-373-1949) or at the Plainwell District Office (616-692-6970 or 616-692-2120).

Glossary of Acronyms and Abbreviations

AOC	Area of Concern	PRP	Potentially Responsible Party
ATSDR	Agency for Toxic Substances and Disease Registry	RAP	Remedial Action Plan
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes	RI/FS	Remedial Investigation/Feasibility Study
CES	Cooperative Extension Service	RPP	River Partners Program
D.O.	Dissolved Oxygen	SA	Sewer Authority
GEM	Groundwater Education in Michigan	SWCD	Soil and Water Conservation District
GIS	Geographic Information Systems	SWMLC	Southwest Michigan Land Conservancy
KRPA	Kalamazoo River Protection Association	SWQD	Surface Water Quality Division
MDA	Michigan Department of Agriculture	ug/L	micrograms per liter
MDCH	Michigan Department of Community Health	USDA	U.S. Department of Agriculture
MDEQ	Michigan Department of Environmental Quality	USEPA	U.S. Environmental Protection Agency
MDNR	Michigan Department of Natural Resources	USGS	U.S. Geological Survey
mg/kg	milligrams per kilogram	WMU	Western Michigan University
mg/L	milligrams per liter	WWSL	Waste Water Sewage Lagoon
mL	milliliter	WWTP	Waste Water Treatment Plant
MSU	Michigan State University		
NPDES	National Pollutant Discharge Elimination System		
NPL	National Priorities List (Superfund)		
NPS	Nonpoint Sources		
NRCS	Natural Resources Conservation Service		
PAC	Public Advisory Council		
PCBs	Polychlorinated Biphenyls		
ppm	parts per million		

AN INTRODUCTION TO THE KALAMAZOO RIVER AREA OF CONCERN

Areas of Concern (AOC) are specific geographic areas having degraded environmental quality because of the presence of contaminants and the impairment of the waters, fish and wildlife, habitat, or aesthetic values of the resource. These sites were officially recognized by the governments of Canada and the United States in 1987 in an amendment to the 1978 Great Lakes Water Quality Agreement.



Great Lakes Basin Areas of Concern

The Kalamazoo River Area of Concern, one of forty-three in the Great Lakes Basin and one of fourteen in Michigan, includes the lower portion of the watershed from Morrow Dam in Kalamazoo County near Galesburg to the mouth of the River in Allegan County at Saugatuck. The Kalamazoo River was identified as an AOC because of the presence of polychlorinated biphenyls (PCBs), discharged primarily from historical deinking operations at local paper mills. Several sources of PCB contamination have been identified along the Kalamazoo River and Portage Creek. The upstream sources of PCBs are collectively referred to as the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site and include four separate operable units: Allied Paper-Bryant Mill Pond, Willow Boulevard/A-Site landfill, King Highway landfill, and the 12th Street landfill. The area is listed as a site of environmental contamination and was officially included on the Superfund National Priorities List in August 1990.

Remedial Action Plans (RAPs) are management plans required by the Great Lakes Water Quality Agreement for each AOC. They embody a comprehensive ecosystem approach to restoring and protecting beneficial uses in an AOC. The RAP is a document outlining beneficial use impairments and recommendations for action. RAP producers include the Public Advisory Council and environmental and wildlife specialists from local, state and federal agencies.

A Public Advisory Council (PAC) for the Kalamazoo River Area of Concern was established in 1993 to direct the RAP process, including RAP development, implementation, associated public involvement, and educational issues. The PAC consists of individuals representing a variety of interests in the watershed and, in addition to overseeing RAP activities, also serves as a liaison between those directly involved in the RAP process and the general public.

Restoration and protection of the Kalamazoo River aquatic ecosystem and protection of public health are the overall goals of the Remedial Action Plan process for this Great Lakes Area of Concern.

The International Joint Commission, in a summary of its proposed priorities for the biennial cycle (1993-1995), stressed “the need to remember that what we do to the Great Lakes, we do to ourselves and to our children. In fact, the damage to our children may well be worse. This realization has moved the Commission to increase the level of resources committed to human health in the Great Lakes basin, in the context of a continuing focus on overall ecosystem health.”

BACKGROUND OF THE KALAMAZOO RIVER WATERSHED

GEOGRAPHY

In the United States there are eleven major river systems watersheds, areas drained by a river system. The Great Lakes Basin is drained by the St. Lawrence River. A few statistics:

- The basin stretches 750 miles from New York State to Minnesota, about 550 miles from northern Ohio to central Ontario, and includes the five Great Lakes.
- Total coastline in the U.S. and Canada is 9,400 miles (4,503 miles in the United States; Michigan's Great Lakes coastline is 3,200 miles).
- One fifth of the world's fresh surface water is located in the Great Lakes, which covers an area of 94,000 square miles.
- Twenty percent of the U.S. population, about 40 million people, live in the Great Lakes region; sixty percent of the Canadian population, about 6 million people, live in the Great Lakes Basin.

Kalamazoo River Watershed

The Kalamazoo River watershed is located in the southwest portion of Michigan's Lower Peninsula and drains about 2,020 square miles from 10 counties: Allegan, Barry, Calhoun, Eaton, Hillsdale, Jackson, Kalamazoo, Kent, Ottawa, and Van Buren. The watershed is about 162 miles long and varies in width from 11 to 29 miles.

The Kalamazoo River watershed is contained entirely within the Michigan/Indiana Till Plains Ecoregion. Ecoregions are defined using a combination of factors including land use, land surface form, native vegetation and soils. Characteristics of this region include irregular plains (mix of relatively level lands and rolling hills and valleys); potential natural vegetation of oak, hickory, beech, and maple; land use of cropland with pasture, woodland, and forest; and gray-brown podzolic soils.

There are about 2,450 lakes and ponds totaling 37,500 acres scattered across the watershed, ranging in size from Gun Lake (Allegan/Barry Counties) at 2,611 acres to numerous small ponds. There are 52 lakes or impoundments of 100 acres or more in size. A summary by county is shown below:

County	Number of Lakes over 100 Acres	Total Surface Acres
Allegan	17	5,510
Barry	11	5,560
Kent	0	0
Calhoun	12	2,360
Eaton	1	130
Hillsdale	0	0
Jackson	2	340
Kalamazoo	9	3,880
Ottawa	0	0
Van Buren	0	0

Kalamazoo River And Its Tributaries

The North and South branches of the Kalamazoo River originate within a few miles of each other: the North Branch originating in Farewell and Pine Hills lakes in southern Jackson County and the South Branches rising in marshy areas south of Moscow in northeastern Hillsdale County. The two branches join at Albion, forming the mainstem which flows northwesterly for approximately 123 miles before entering Lake Michigan near Saugatuck. Along the way, the river flows through several municipalities: Marshall, Battle Creek, Augusta, Galesburg, Comstock, Kalamazoo, Parchment, Plainwell, Otsego, Allegan, and Saugatuck.

There are numerous tributaries and drains that discharge into the Kalamazoo River. Major tributaries are listed below. Lengths are shown in miles. Those with an (*) are within the Area of Concern.

North Branch Kalamazoo River	28.0	Spring Brook*	6.0
South Branch Kalamazoo River	43.0	Gun River *	13.0
Rice Creek (North and South Branches)	29.5	Miner Creek*	7.0
Wilder Creek	10.5	School Section Creek*	3.0
Seven Mile Creek	4.0	Schnable Brook*	4.0
Wabascon Creek	16.0	Swan Creek*	16.5
Battle Creek River	46.0	Bear Creek*	6.5
Wanadoga Creek	12.0	Sand Creek*	3.5
Indian Creek	9.0	Mann Creek*	6.0
Big Creek	6.0	Rabbit River*	46.5
Augusta Creek	15.0	Little Rabbit*	14.0
Gull Creek	8.0	Red Run Drain*	7.0
Davis Creek*	6.0	Black Creek*	15.0
Arcadia Creek*	2.5	Miller Creek*	7.0
Portage Creek (includes West Branch)*	18.5	Miller Creek*	3.5
Pine Creek*	6.0	Silver Creek*	2.0
Baseline Creek		Green Lake Creek*	7.0
4.0			
Sand Creek	4.0		

The **North Branch** above Concord is a small, clear water stream that varies in size from ten feet wide by four inches deep below Farewell Lake to 35 feet wide by one foot deep above the Concord impoundment. The bottom type, in general, through this stretch of stream is sand with some areas of gravel.

The **South Branch** from Homer to Albion is a larger river averaging 40 feet wide by 18 inches deep in the upper areas to 70 feet wide by two feet deep in the lower areas. There are a few flat areas in marsh situations where the river may widen up to 100 feet and the water is quite shallow (eight inches or less). Bottom types are mostly sands and gravel with some rubble and boulders in the riffle areas.

More than half the length of the mainstem between Albion and Ceresco (east of Marshall) is impounded or heavily developed in the cities of Albion and Marshall. The mainstem of the Kalamazoo River from Ceresco to the southwestern edge of Battle Creek flows through scenic natural areas and includes several islands. The river is about 80-100 feet wide and averages 1-2 feet deep. The river bottom has many areas of gravel and aquatic weeds. Through Battle Creek and adjacent suburbs, the river is almost entirely within developed areas. The Fort Custer Recreation area is in the area between Battle Creek and Augusta.

From Augusta to Galesburg there is little development, except in the villages. The river is wide and deep, averaging 110 feet wide and four feet deep. Low stream banks are well vegetated with soft maple, willow, and ash. Between Galesburg and Comstock, the river flows into Morrow Pond, an impoundment created

by the Brice E. Morrow power plant dam. From this point, the river flows through more urbanized areas of Kalamazoo. From Kalamazoo, the river flows north through natural and agricultural areas to Plainwell. With the river gradient increasing to 2.6 feet per mile between Plainwell and Allegan, five dams were constructed in this stretch of the river (three have been partially removed).

From Allegan the river flows into Lake Allegan behind the Calkins power dam. From here it flows through the wildest section of the river, Allegan State Game Area. A major tributary, the Rabbit River, enters the Kalamazoo a few miles upstream from Lake Kalamazoo. Near the mouth of the Kalamazoo River there are extensive marshlands. The Kalamazoo River outlets to Lake Michigan at Saugatuck through a constructed channel.

PHYSICAL FEATURES

Climate

Climate describes the general weather conditions over a long period of time in a given area. Michigan, located about halfway between the equator and the north pole, has a temperate climate with four distinct seasons a year. Climate in areas near the Great Lakes, including western parts of the Kalamazoo River watershed, is also influenced by “lake effects.”

Some facts about climate in the Kalamazoo River watershed:

- Varies from modified marine (Great Lakes influence) in the AOC to continental in the eastern portions
- Average annual precipitation is about 32 inches; average snowfall exceeds 40 inches; in the AOC, annual snowfall approaches 100 inches
- Average July temperature is 72 degrees Fahrenheit and average January temperature is about 24 degrees; average January temperature is slightly warmer (26 degrees) near Lake Michigan; annual mean temperature for the area is about 49 degrees
- Average growing season ranges from about 153 days at the eastern end of the watershed to about 184 days along Lake Michigan

Geologic History

Ancient Geology. The geologic history of the Kalamazoo River watershed and that of the Great Lakes Basin are intertwined. The foundation of the present Great Lakes Basin formed about 3 billion years ago during a period of great volcanic activity, followed by a 360 million year period of great deposition of materials that became limestone, shale, sandstone, gypsum, and halite (salt). Between the end of this period and about a million years ago, land plants and animals (including dinosaurs) flourished.

Glacial Geology. That part of geologic history most affecting the modern landscape was the glacial period, beginning about one million years ago. As the climate cooled, snow and ice accumulated to become glaciers (sometimes up to 6,500 feet thick) that inched their way across the Great Lakes region, altering the landscape. As the glacier moved, everything in its path was scraped, crushed, and ground down and frozen in the glacial ice. As the climate warmed again, the ice melted shrinking the glacier and depositing sand, silt, clay, and all sizes of rocks and boulders, collectively referred to as glacial drift. This cycle of glacial formation and retreat was repeated several times.

The retreat of the glaciers and the deposition of glacial drift left most of the landscape of hills, valleys, flatlands, rivers, streams, and lakes of the Kalamazoo River Basin. Erosion and the effects of human activity have modified the landscape over the last 10,000 years since the end of the last glacial period. Glacial drift extends to a depth of more than 400 feet in the western portions of the watershed to 50 feet or less east of Battle Creek.

Topography

Topography describes the surface features of an area. The topography of the Kalamazoo River watershed has been influenced primarily by glacial activity.

The entire region has a generally rolling landscape with flat or gently rolling plains, wetlands and open water, and hilly sections interspersed across the watershed. Glacial surface features include ground and terminal moraines (linear hills or hill systems of poorly sorted material), outwash (course textured material more randomly deposited by the glacier), eskers (materials well sorted by glacial meltwater), and

kettle lakes (lakes resulting from massive pieces of ice breaking off the glacier and later melting). Drainage patterns resulted, in large part, from glacial activity.

Elevation of a few selected sites in the watershed include: Jackson (1003 ft.), Battle Creek (934 ft.), Gull Lake (934 ft.), Kalamazoo (930 ft.), and Allegan (629 ft.).

Topographic facts about the Kalamazoo River:

- Slow to moderate stream gradient, dropping 540 feet in elevation from its headwaters on the South Branch (1,120 ft. above sea level) to Lake Michigan (580 ft. above sea level). Elevation at the headwaters of the North Branch is 1,042 ft. above sea level.
- The average drop in elevation over the 166 miles of mainstem and South Branch is just over 3 feet per mile.
- The watershed contains approximately 542 linear miles of major streams (34 streams identified as major). There are many other small streams and drains.

Within the Area of Concern, low areas along the River, referred to as valley plains, are mostly old glacial drainageways not more than a mile or two wide and traversed by streams. Since earlier glacial activity, some streams have cut a lower plain a few feet deep, now covered by more recent flood plain deposits and intersected, in places, by streams flowing into the River. Although dry in places, most of these flatlands have a high water table, large areas of muck soil with wet sandy loams and loams of medium fertility, so that the river channel is bordered by wetlands.

The Michigan Natural Features Inventory (March 1994) lists two unique geological features for Kalamazoo County: drumlin and pitted outwash. Formed by glacial action, *drumlins* are elliptically shaped streamlined hills of unsorted mixture of all shapes and sizes of rocks, sand, and other materials. Also glacial in origin, *pitted outwash* refers to areas in front of moraines (hill systems formed by the glacier) with lakes, ponds, and dry depressions.

Soils

Soil is that layer of material on the land's surface made up of varying sizes of rock particles (gravel, sand, silt, clay) and decayed plant and animal matter (humus). Loam is soil with approximately equal parts of sand, silt, and clay. Different loams contain varying proportions of these materials.

Soils in the watershed are as diverse as the glacial materials in which they are found. They range from clay and silt to sand and organic materials. About 25% have clay loam or clay textures (found mostly in Eaton County and to a lesser extent in Allegan and Van Buren Counties). Forty percent are sandy loams and loams of intermediate texture (found primarily in Calhoun, Allegan, Barry, and Kalamazoo Counties). Soils with loamy sand and sandy textures make up approximately 30% of the land (found mostly in the western part of the basin). The remaining 5% are organic and are distributed through the basin, usually in river bottoms.

To learn more about soils, refer to the County Soil Surveys published by and available from the USDA, Natural Resources Conservation Service.

Hydrology

Hydrology describes the distribution and movement of water in an area. The U.S. Geological Survey shows the following about the amount of water moving past three monitoring stations on the Kalamazoo River. Discharge is in cubic feet per second (cfs).

MONITORING STATION	PERIOD OF RECORD	AVERAGE DISCHARGE
Battle Creek	1937-1985	664 CFS
Comstock	1933-79, 1985	853 CFS
Fennville	1929-1985	1,430 CFS

The mean monthly flow rates, in cubic feet per second, to Lake Michigan, as estimated by the Michigan Department of Natural Resources, are:

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1620	1740	2370	2490	1990	1500	1200	1030	1030	1180	1500	1620

GROUNDWATER. Groundwater is water below the land surface, occupying the spaces between the grains that make up soils and deposits of clay, sand, and gravel. Groundwater movement is frequently towards surface waters, and many lakes and streams are “recharged”, or fed, by groundwater. Contaminated groundwater can affect the quality of water in the Kalamazoo River and its tributaries.

BIOLOGICAL FEATURES

Ecology Of The Watershed

Physical and chemical features combine to provide conditions that support a variety biological communities. The influence of Lake Michigan in moderating the climate of the region has provided a niche for a variety of native plant species. Certain types of agriculture also flourish because of the moderating effects of Lake Michigan on the regional climate. Certain locations in the watershed are prime natural habitats for both common and unusual species of plants and animals. Examples include Allegan State Game Area, Kalamazoo Nature Center, Baker Sanctuary, and Barry State Game Area. A summary of flora and fauna of the watershed is presented below.

Native Plant Communities

There are six major types of native plant communities in the watershed. While each is a distinct community, there are many transitional zones (called ecotones) that exist between these communities. Some of the dominant species are found in many different communities and may be prevalent in more than one area.

Community	Characteristics
<i>Dry Southern Hardwood Forest</i>	Forests of dry upland sites with burr oak, black oak, or white ash dominating
<i>Moist Southern Hardwood Forest</i>	Forests that occur in moist soils and are dominated by beech and sugar maple
<i>Wet Lowland Forest</i>	Forests characterized by willow or cottonwood, or silver maple or ash
<i>Grassland-Savanna Complex</i>	Includes the combination of prairies, sedge meadows and savannas, characterized as treeless or with scattered trees and dominated by grasses or sedges either wet or dry
<i>Marshes and Emergent Aquatic Communities</i>	Treeless areas in which the water table is above the soil surface during most of the growing season
<i>Submerged Aquatic Communities</i>	Essentially lakes and ponds, the dominant plant species in these communities are below or on the water surface

In the Michigan Natural Features Inventory (March 1994) for Allegan and Kalamazoo Counties, several unique plant communities are listed:

Allegan

Dry Sand Prairie
 Dry-Mesic Northern Forest
 Dry-Mesic Southern Forest
 Great Lakes Marsh
 Interdunal Wetland
 Lakeplain Wet-Mesic Prairie
 Mesic Southern Forest
 Oak Barrens
 Open Dunes
 Prairie Fen

Kalamazoo

Coastal Plain Marsh
 Mesic Prairie
 Mesic Southern Forest
 Prairie Fen
 Southern Floodplain Forest

Note: mesic is a habitat with well-drained soils, but with an ample amount of moisture; a fen is a wetland with saturated muck soils, neutral to strongly alkaline.

Animal Life

Both resident and migratory, nongame and game animals are found throughout the watershed. An inventory of animals of the Allegan State Game Area, included in a 1992 master plan for the area, listed 235 bird species, 45 mammal species, 19 amphibian species, 76 fish species and 23 reptile species.

Important resident game species include the white-tailed deer, cottontail rabbit, fox squirrel, gray squirrel, raccoon, ring-necked pheasant, ruffed grouse, bobwhite quail, and wild turkey. Furbearing mammals include mink, muskrat, red fox, skunk, opossum, weasel, woodchuck, gray fox, badger, and beaver.

Important species of waterfowl, commonly taking up summer residence, include the mallard duck, black duck, wood duck, Canada goose, blue-winged teal, and American coot. Others, found only during spring and fall migration, include the blue goose, whistling swan, redhead duck, canvasback, goldeneye, American merganser, bufflehead, lesser scaup, American gallinule, Wilson's snipe, baldpate, pintail, and green-winged teal. The American woodcock is a migratory forest species.

The Michigan Natural Features Inventory (March 1994) for Allegan and Kalamazoo Counties list plants and animals, occurring in these counties, considered endangered (in danger of extinction in the state), threatened (likely to become endangered in the foreseeable future), or of special concern (not threatened or endangered at present but could be in the future and should be monitored) under state statutes.

Allegan County	Kalamazoo County
<u>Endangered</u> : 4 plants and 4 animals	<u>Endangered</u> : 4 plants and 5 animals
<u>Threatened</u> : 25 plants and 7 animals	<u>Threatened</u> : 50 plants and 2 animals
<u>Special Concern</u> : 19 plants and 7 animals	<u>Special Concern</u> : 39 plants and 9 animals
	<u>Extirpated (no longer found in the area)</u> : 4 plants

HUMAN RESOURCES

Demographics

Approximately 400,000 people live in the watershed, with most concentrated in the metropolitan areas of Kalamazoo and Battle Creek. There are 21 cities and villages, located on the River or a tributary, and all or part of 76 townships in the watershed. Other population centers (1990 census figures in parentheses), in addition to Kalamazoo (80,277) and Battle Creek (53,540), include Portage (41,042), Albion (10,066), Marshall (6,891), Plainwell (4,057), Otsego (3,937), and Allegan (4,547). There are both urban and rural minority populations, including African Americans and Hispanics. Small Native American communities are located in Allegan County.

There are all or part of 31 public school districts, all or part of four community college districts (Jackson, Kellogg, Kalamazoo, and Grand Rapids), one public university (Western Michigan University), and three private colleges (Albion, Kalamazoo, and Davenport).

All or part of three U.S. Congressional districts, several State Senate districts, and several State Representative districts are included in the Kalamazoo River watershed. There are 18 circuit court judges, 20 district court judges, and nine probate court judges serving the area. Because parts of ten counties are in the watershed, there are 10 prosecuting attorneys, sheriffs, county clerks, registers of deeds, and treasurers serving the watershed. Each county, city, village, and township also has elected officials, as well as several regulatory and advisory agencies and boards, such as the drain commissioner, health department, planning divisions, and zoning commissions.

Land Use

There are 2,020 square miles of land in the Kalamazoo River watershed, approximately 1.3 million acres, currently used in the following ways:

Cropland and Pasture	57%	Forest Land	21%	Urban Areas	8%
Wetlands	3%	Open Water	2%	Other Uses	9%

Ninety-six percent of the land in the Kalamazoo River watershed is privately owned. The remaining 55,000 acres are publicly owned. Major public areas include Allegan State Game Area (48,000 acres), Fort Custer Recreation Area (3,000 acres), and about one-fifth of the Yankee Spring Recreation Area (1,000 acres). Ownership along the mainstem of the Kalamazoo River in the AOC is approximately half public and half private. River frontage on the Rabbit River, a major tributary of the Kalamazoo River, is all in private ownership.

Agriculture

Major grain crops include corn, soybeans, wheat, and oats. Considerable land is also used for pasture and growing alfalfa. Major fruit crops include apples, peaches, pears, blueberries, and strawberries. Some truck farming is also found in the watershed. Specialty crops/products include maple syrup, honey, wines and fruit juices, bedding plants, nursery stock, and Christmas trees. Dairy and beef cattle, sheep, and pigs are also raised in the watershed. Poultry farms produce chickens, turkeys, and eggs.

Industrial/Commercial

There is a mix of light and heavy industry with large and small firms providing diverse products and services, including paper products, pharmaceuticals, cereal and other food products, printing and packaging, automobile and aircraft parts, and office furniture. Most are centered in larger population

areas, although some are located in small cities and villages. Major commercial areas (retail shopping centers, restaurants, and other consumer services) are centered in the two largest cities: Battle Creek and Kalamazoo. Smaller retail and service providers are found in towns and villages.

Residential

Urban, suburban, and rural residential areas are found in the watershed. A variety of housing types are also found, including single-family homes, apartments and major apartment complexes, planned unit development communities, and senior citizen and other residences and cooperatives.

Transportation

Automobile, truck, train, and airplane transportation is readily available in the watershed. A major portion of Interstate 94 traverses the watershed from Jackson to Kalamazoo. Major intersections include Interstate 69 at Marshall and U.S. 131 at Kalamazoo. Lesser state highways include M-89 from Battle Creek to Allegan, M-43 and M-96 in Kalamazoo County, M-99 and M-60 in Calhoun and Jackson Counties. Amtrak/Conrail parallels Interstate 94 from Jackson to Kalamazoo, with a major rail yard in Battle Creek and a smaller one adjacent to the river in Kalamazoo. Primary air passenger service is at Kalamazoo/Battle Creek International Airport, with major air freight service from Battle Creek. Local airports are located at Albion, Marshall, Plainwell, and Allegan.

Recreational Uses

Campsites, ranging from rustic tent sites to modern trailer/recreation vehicle sites, are found in private and public campgrounds. Private recreational facilities provide a variety of services, including golf courses, archery ranges, horseback riding, boat and canoe rentals, marinas, Great Lakes charter boat services, fishing ponds, skiing, snowmobiling, and sledding. Several parks and launch sites allow direct access to the Kalamazoo River.

Two state parks and a major state game area are located in the watershed. Fort Custer Recreation Area, a 2,960 acre state park, is located on the Kalamazoo River between Kalamazoo and Battle Creek. Yankee Springs Recreation Area, a 5,000 acre state park (of which about 1,000 acres are in the watershed along the Gun River tributary), is located northeast of Plainwell. The Allegan State Game Area, with 48,000 acres, is the largest state-owned area in the watershed and is traversed by the Kalamazoo River. Other state-owned recreational properties in the watershed include a portion of the Kal-Haven Trail Sesquicentennial State Park and several game areas. Fort Custer, Yankee Springs, and Allegan provide day-use and overnight facilities.

There are several major city and county parks. Major ones include Markin Glen, River Oaks, Coldbrook, Milham, Verberg, and Kindleberger Parks in Kalamazoo County and Littlejohn Lake, Dumont Lake, and Oval Beach in Allegan County. City/village parks and river walks providing access to the River are found in Albion, Marshall, Battle Creek, Kalamazoo, Parchment, Plainwell, Otsego, Allegan, and Saugatuck.

Department of Natural Resource launch sites on the River are located at Morrow Lake in Kalamazoo County and Lake Allegan, Allegan Dam, Palmer Bayou, Ottawa Marsh, New Richmond, Indian Point, and Lake Kalamazoo in Allegan County. There are numerous launch sites at lakes in the watershed.

In addition to the state parks and game areas described above, several privately owned nature areas/preserves are found in the watershed. Sites with major visitor facilities include the W.K. Kellogg Biological Station, the Kalamazoo Nature Center, and Binder Park Zoo in Battle Creek. The Michigan Nature Conservancy sites include Jenney Woods. Southwest Michigan Land Conservancy also has preserves in the watershed. These sites, as well as the state, county, and municipal parks, walkways, and

launch sites, provide opportunities to observe the plants, animals, and natural and manmade landscapes of the Kalamazoo River watershed.

Water Use

Industrial and Commercial. There are several industrial water intake sites along the Kalamazoo River. Industries and commercial businesses also use the river for discharging treated wastes, cooling water and other effluents either directly (Appendix A) or via municipal sewage treatment facilities.

Residential. There are no municipal drinking water intakes on the River. The main source of drinking water is from groundwater wells, private and municipal. Residential wastes are discharged to groundwater via septic systems, or to the River via municipal sewage treatment facilities.

Recreational. Fishing and boating are the major recreational uses of the River. The Kalamazoo River supports a warm water fishery, and some tributaries are cool enough to support quality trout fisheries. A fish consumption advisory exists on that section of the River in the Area of Concern. Motorized boating for fishing and water sports is common on Lakes Allegan and Kalamazoo (at Saugatuck) and adjacent sections of the River. Canoeists make use of much of the length of the River.

Agricultural. There is some intake of River water for irrigation of crops. The Kalamazoo River and its tributaries are also used extensively for watering livestock.

Waste Discharge. Several municipal sewage treatment facilities discharge treated waste water into the Kalamazoo River. There are also many other permitted surface water discharges (Appendix A).

HUMAN HISTORY

Humans and the Kalamazoo River: A Summary

Prehistoric Period: Beginning in 1975 Western Michigan University anthropologists conducted field studies at many sites along the length of the Kalamazoo River to learn more about prehistoric human habitation. More than 400 separate sites were identified in Allegan County ranging in evidence of a single item to that of a complete campsite. Results of the study show that humans have used the Kalamazoo River basin continuously for more than 11,000 years. Artifacts from every prehistoric era have been found. Few permanent settlements, however, were found along the river. Studies and historic written records indicate the area was used seasonally for hunting, fishing, and maple sugaring. It is thought that the basin did not have the kinds of soils necessary to encourage permanent settlements. However, from about 700 years ago, there has been some farming by Native Americans.

Historic Period: Probably the earliest Europeans to glimpse mouth of the Kalamazoo River were Jesuit Priest Father Jacques Marquette and two companions as they were returning from visiting Indians in Illinois in 1675. Although other missionaries may subsequently have passed the mouth of the River, it wasn't until the late 1700s that the area was frequented by fur traders. By the early 1800s, there were several small communities along the River, including Kalamazoo. Farmers soon replaced fur traders and quickly populated much of the watershed. Many shipped their goods down the River on flat boats to Singapore, established at the mouth of the River in the 1830s. This "bustling port," abandoned in the 1870s, was later buried by the shifting sand dunes. With the introduction of the Railroad in the 1840s, the importance of the River for transportation declined.

By the mid-1800s, several communities had grown up along the River as mill towns and commercial centers: Battle Creek, Kalamazoo, Parchment, Plainwell, and Otsego. After the Civil War and into the 20th century, various industries, from cereal production to pharmaceuticals to automobile parts, flourished. Several communities became sites for paper production, which used the River for water intake and waste discharge. Deinking practices no longer in use led to PCB contamination of the River. Sewage effluent, other industrial discharges, and trash also contributed to the pollution of the River. For many years in the 1940s, 50s, and 60s, the River was an "eyesore" and most people did their best to avoid it. Beginning in the 1970s with the federal Clean Water Act, serious efforts were made to clean up the River. Although today the River is cleaner, the persistent PCB contamination has led to Superfund designation of a 35-mile section from Kalamazoo to Allegan Dam.

Historic Sites: There are historical museums and historic homes in most communities in the watershed. Major sites include: Kalamazoo Public Museum, Battle Creek Historical Society Museum, Allegan County Historical Society Museum (including restorations at the Allegan County Fairgrounds), DeLano Homestead, and historic sites in Saugatuck.

Perspectives On The River

In the fall of 1990 the Kalamazoo River Partners of the Forum for Kalamazoo County conducted interviews with leaders from 33 organizations, representing the interests of business, government, education, recreation, and the general public. The purpose of survey was to inventory existing and proposed development along the river and ask for each community leader's personal visions for the future of the Kalamazoo River. The following are sample comments. They indicate the diverse perspectives about the River.

- "We are dealing with three issues when we discuss the Kalamazoo River: water quality, land usage, and land development. Each of these is a massive project in itself."
- "First we need to address the image problem of the River. People still think that it's as bad as in the past. Not the case."
- We have "ignored the river for years. It has been used as a public sewer for years. I believe it is the responsibility of government to provide the people with access to the river so it can be enjoyed."
- "If the river is accessible to people to use for recreational activities, other uses will follow. Expand the Red Arrow Golf Course to the other side of the river. Incorporate housing in and around the course. Establish walkways, bike paths, cross-country ski trails along the river."
- "The Kalamazoo River is a major geographical feature of our region. The river will eventually be discovered in Kalamazoo much as it has been in Allegan and Battle Creek. The river is a great place to recreate whether it is an afternoon canoe ride or a fishing trip."
- "The River's legacy of PCB contamination will be with us for along time. An increased awareness of the River's problems and potential may nurture a sense of stewardship towards this unique natural resource: a resource we might someday be proud to leave our children."
- "Development along the River needs to respect the rights of industry. Without the river, some industries could not function. This needs to be kept in mind when forming a plan for the River."
- "The Kalamazoo River is a major asset of this community which is not being fully utilized. We have a responsibility to raise awareness of what can be done on a coordinated basis."
- "Clean up the river and develop a linear park within the City. The impetus for river development will be the Arcadia Creek project."
- "We need to protect and clean up the river from all aspects of pollution. We should encourage recreational uses, but be sure these aren't contributing to more pollution. Also, we need to be careful to keep the environment beneficial for all users of the river, like farmers who need green space near the river to prevent erosion."

RESOURCE IMPAIRMENTS

CAUSES OF DEGRADATION, ONGOING AND RECOMMENDED ACTIONS

Impairments

As an initial part of the RAP process *beneficial use impairments* of surface waters have been evaluated for each Area of Concern. Fourteen *beneficial use impairments*, as set forth in the Great Lakes Water Quality Agreement, are used as “yardsticks” of ecosystem health. Listing guidelines for each of the 14 *beneficial use impairments* have been developed by the International Joint Commission. These guidelines are provided in the table on the following page.

In the Kalamazoo River Area of Concern, 8 of the 14 *beneficial uses* are considered impaired:

1. Restrictions on fish and wildlife consumption.
2. Degradation of fish and wildlife populations.
3. Bird or animal deformities or reproductive problems.
4. Degradation of the benthos.
5. Restrictions on dredging activities.
6. Restrictions on body contact.
7. Loss of fish and wildlife habitat.
8. Degradation of aesthetics.

For a more detailed summary of these impairments, see the table on pages 24 and 25.

Six of the Great Lakes Water Quality Agreement *beneficial uses* are not impaired in the Kalamazoo River:

1. There have been no reports of tainted fish or wildlife flavor.
2. There have been no reported fish tumors or other deformities.
3. A number of lakes in the Kalamazoo River AOC are considered eutrophic (high nutrient concentrations resulting in significant rooted plant or algae growth). In some stretches of the Kalamazoo River water quality standards are sometimes not met for phosphorus and dissolved oxygen. However, the Kalamazoo River has not been designated a eutrophic body of water. A Total Maximum Daily Load (TMDL) study of phosphorus is underway for Lake Allegan (an impoundment of the Kalamazoo River), which is considered eutrophic. This MDEQ study will evaluate upstream sources of phosphorus to the River and determine the degree to which phosphorus inputs need to be controlled.
4. Most residents of the Kalamazoo River AOC draw their drinking water from groundwater sources, therefore “restrictions on drinking water consumption or taste and odor problems” are not considered an impaired use in this AOC.
5. There are no known additional costs to agriculture or industry for treatment of river water prior to it’s use.
6. Plankton populations in the Kalamazoo River and it’s tributaries do not currently appear to be impaired.

Use Impairment	International Joint Commission Listing Guideline
Restrictions on fish and wildlife consumption	When contaminant levels in fish or wildlife populations exceed current standards, objectives or guidelines or public health advisories are in effect for human consumption of fish or wildlife. Contaminant levels in fish and wildlife must be due to contaminant input from the watershed.
Tainting of fish and wildlife flavor	When ambient water quality standards, objectives or guidelines for anthropogenic substances known to cause tainting are being exceeded or survey results have identified tainting of fish and wildlife flavor.
Degradation of fish and wildlife populations	When fish and wildlife management programs have identified degraded fish or wildlife populations due to cause within the watershed. In addition, this use will be considered impaired when relevant, field validated fish or wildlife bioassays with appropriate quality assurance/quality controls confirm significant toxicity from water column or sediment contaminants.
Fish tumors or other deformities	When incidence rates of fish tumors or other deformities exceed rates at unimpacted control sites or when survey data confirm presence of neoplastic or pre-neoplastic liver tumors in bullheads or suckers.
Bird or animal deformities or reproductive problems	When wildlife survey data confirm presence of deformities (e.g. cross-bill syndrome) or other reproductive problems (e.g. egg-shell thinning) in sentinel wildlife species.
Degradation of benthos	When the benthic macro-invertebrate community structure significantly diverges from unimpacted control sites of comparable physical and chemical characteristics. In addition, this use will be considered impaired when toxicity of sediment-associated contaminants is significantly higher than controls.
Restrictions on dredging activities	When contaminants in sediments exceed standards, criteria, or guidelines such that there are restrictions on dredging or disposal activities.
Eutrophication or undesirable algae	When there are persistent water quality problems attributed to cultural eutrophication.
Restrictions on drinking water consumption or taste and odor problems.	When treated drinking water: 1) exceeds standards, objectives, or guidelines for disease organisms, hazardous/toxic chemicals, or radioactive/toxic substances, 2) taste and odor problems are present, 3) treatment required for raw water is beyond standard treatment for the Great Lakes area.
Restrictions on body contact	When waters commonly used for full or partial body contact recreation exceed standards, objectives or guidelines for such use.
Degradation of aesthetics	When any substance in water produces a persistent objectionable deposit, color, turbidity, or odor.
Added cost to industry or agriculture.	When additional treatment is required prior to use.
Degradation of plankton populations.	When populations significantly differ from unimpacted control sites.
Loss of fish and wildlife habitat.	When fish and wildlife management goals have not been met as a result of loss of habitat due to perturbations of physical, chemical, or biological integrity.

There are currently eight use impairments in the Kalamazoo River Area of Concern.

Kalamazoo River Area of Concern Use Impairments

Use Impairment	Explanation of Impairment	Scope of Impairment	Action Required
Restrictions on fish and wildlife consumption	Fish consumption advisories since 1977 because of PCB concentrations in fish tissue. River sediments are the current source of PCBs.	From Battle Creek to the mouth of the Kalamazoo River at Lake Michigan; Portage Creek below Monarch Mill Pond.	Contaminated sediments remediation
Degradation of fish and wildlife populations	<p>The warm water fishery is impaired because of habitat loss and poor water quality.</p> <p>Reproductive success has been reduced in some bird and mammal populations because of PCBs in the food web.</p> <p>Introduced species have reduced populations of some native plants and animals.</p>	<p>Most of the watershed experiences some degree of fisheries impairment.</p> <p>From Morrow Dam to the mouth of the Kalamazoo River, and Portage Creek.</p> <p>Watershed-wide</p>	<p>Erosion control; habitat restoration; contaminated sediments remediation.</p> <p>Contaminated sediments remediation.</p> <p>Public education on the control of exotic species.</p>
Bird or animal deformities or reproductive problems	<p>Nesting failure of bald eagles; high PCB concentrations in eggs.</p> <p>PCB concentrations in fish, waterfowl, piscivorous mammals and raptors are at levels known to cause reproductive impairment or deformities.</p>	<p>Allegan State Game Area</p> <p>From Morrow Dam to the mouth of the Kalamazoo River, and Portage Creek from Bryant Mill Pond.</p>	<p>Contaminated sediments remediation</p> <p>Contaminated sediments remediation.</p>
Degradation of the benthos	Bottom-dwelling communities and habitats are moderately to severely degraded in many areas because of the accumulation of excess sediments, low oxygen levels and sediment contamination.	Throughout the watershed. PCB contaminant problems in areas of the Kalamazoo River and Portage Creek already defined.	Erosion control; reduction in nutrient inputs; contaminated sediments remediation.

Use Impairment	Explanation of Impairment	Scope of Impairment	Action Required
Restrictions on dredging activities	Sediments contain concentrations of PCBs which exceed USEPA dredge spoil guidelines.	Kalamazoo River downstream of Morrow Pond, and Portage Creek downstream of Bryant Mill Pond.	Contaminated sediments remediation.
Restrictions on body contact	Swimming and other full body contact activities are not advisable because of poor sediment quality. Concentrations of fecal bacteria exceeding full body contact standards result from storm runoff from livestock waste and septic systems. Localized, seasonal blooms of potentially toxic algae in area lakes <i>may</i> make full body contact activities inadvisable. Zebra mussel colonization suspected as the primary cause of the bloom.	At and immediately downstream of Superfund units. Study is underway to determine if body contact should be limited in other areas. In some tributaries, localized and occasional due to poorly managed livestock waste and septic systems. So far Gull Lake is the only lake in the watershed known to have this type of algal bloom, known as <i>Microcystis</i> .	Contaminated sediments remediation. Proper manure management; proper septic system siting and management. Public education to prevent the spread of zebra mussels to other lakes, and to reduce nutrient inputs to lakes.
Loss of fish and wildlife habitat	Wetland losses have eliminated important habitat for wildlife. Channel straightening, damming and alteration or removal of riparian vegetation alters flow, temperature and other important features.	Throughout the watershed. Throughout the watershed.	Habitat restoration, and efforts to prevent further habitat losses.
Degradation of aesthetics	Occasional spills or runoff events cause odor or visual aesthetics problems	Variable	Continue and improve regulatory and non-regulatory pollution prevention efforts.

PCB CONTAMINATION

Background

Identified as a problem in 1971, PCB discharges into the Kalamazoo River from paper industry deinking processes created very serious pollution problems. PCBs were released directly to the river from the mid-1950s to the mid-1970s via process discharges, and into groundwater and surface water from landfills where contaminated waste products were disposed. PCB discharges from process streams have been essentially eliminated because of a ban on their production and other regulatory point source controls. Paper company landfills, river sediments and groundwater, however, are still heavily contaminated with PCBs, and serve as ongoing sources of contaminants for fish and other wildlife. PCB-laden sediments may also pose human health risks if exposure to those sediments is repeated or ongoing.

MDNR (now MDEQ) completed a Remedial Investigation/Feasibility Study (RI/FS) on the PCB problem in the river in 1986, recommending remedial actions be taken at Bryant Mill Pond, and the Plainwell, Otsego, and Trowbridge impoundments. Further investigation was recommended at the Otsego City impoundment, Allegan City impoundment, and Lake Allegan prior to remedial activities.

In June, 1990 the Michigan Department of Natural Resources (now MDEQ) notified three potentially responsible parties (PRPs), Allied Paper, Inc./HM Holding, the Georgia-Pacific Corporation, and Simpson Plainwell Paper Company (now Plainwell Paper), of their intent to spend public funds to conduct a remedial investigation/feasibility study.

In August 1990, the Allied Paper, Inc./Portage Creek/Kalamazoo River site was included on the National Priorities List, commonly known as Superfund. MDEQ has been designated as the lead agency on this Superfund Site. In December 1990 the State of Michigan entered into an Administrative Consent Order with Allied Paper, Inc., Georgia-Pacific Corporation, and the Simpson Plainwell Paper Company. These potentially responsible parties agreed to fund and conduct a remedial investigation/feasibility study consistent with the Superfund process, in a proper and timely manner. Although not named in the order, James River Corporation has also been participating in these studies as a PRP. In 1997 the Michigan Department of Environmental Quality discovered that Rock-Tenn corporation was discharging PCBs to the Kalamazoo River. Rock-Tenn is therefore being designated a party to the Superfund actions.

The Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site is a 35-mile stretch of the Kalamazoo River and a three mile stretch of Portage Creek contaminated with PCBs. This area includes Portage Creek from Cork Street just above Bryant Mill Pond in the city of Kalamazoo, to its mouth at the Kalamazoo River, and from Morrow Dam on the Kalamazoo River downstream to the Allegan City Dam. Because studies show that PCBs have migrated downstream, the MDEQ has expanded the study area to include these locations. Groundwater testing was recently completed within the Superfund Site; at this time PCB concentrations in ground water do not appear to warrant any cleanup action.

The river and associated land area sites are divided up into operable units for actions. These operable units are the landfills where PCB-contaminated wastes were disposed of in the 1950s, 1960s and 1970s.

Remediation plans for the four operable units, King Highway Landfill, 12th Street Landfill, Willow Boulevard/A-Site Landfills, and the Allied Paper Landfill have recently been or are currently being finalized and approved. Preliminary work has begun at some sites. Remedial activities at most of these sites should commence in 1998 or 1999.

In 1997 the Kalamazoo River Public Advisory Council approached the U.S. EPA requesting emergency action be taken at Bryant Mill Pond to stop continued erosion of PCB-laden sediments to the river. Clean-up of the Bryant Mill Pond is scheduled for the summer of 1998.

Final evaluations on PCB contamination in the Kalamazoo River is underway. A decision on remediation plans for the Kalamazoo River is expected in 1999.

Resource Evaluation

PCB-contaminated sediments are responsible for the following impairments: restrictions on fish consumption, degraded fish and wildlife populations, animal reproductive problems, degradation of the benthos, restrictions on dredging activities, and localized restrictions on body contact.

Surface Waters and Sediments

Numerous studies have documented concentrations of PCBs in surface waters and sediment that far exceed water and sediment quality standards or guidelines. Surface water samples collected between 1985 and 1987 by the MDNR (now MDEQ) in Portage Creek and the Kalamazoo River downstream of PRP facilities exceeded the USEPA chronic ambient water quality criteria (AWQC) of 0.014 ug/L (ppb) and Michigan Water Quality Standard of 0.00002 ug/L (ppb) in 27 out of 27 samples and 56 out of 79 samples, respectively. In 1993, 21 of 23 Portage Creek surface water samples from downstream of PRP facilities exceeded the AWQC. The maximum concentration measured was 0.23 ug/L (ppb) PCB.

Kalamazoo River sediment PCB concentrations exceed USEPA interim sediment quality criteria of 2.47 mg/kg (ppm), and the Michigan Water Quality Standards for the protection of aquatic life. Concentrations at some locations are ten or more times greater than sediment criteria, including 180 mg/kg (ppm) in sediments near Otsego Dam, 67 mg/kg (ppm) near Plainwell, 48 mg/kg (ppm) downstream of Georgia-Pacific, and 42 mg/kg (ppm) in Lake Allegan.

PCB sediment concentrations in Portage Creek also exceed sediment criteria. Concentrations as high as 369 mg/kg (ppm) have been measured in Portage Creek sediments.

Human Contact with Contaminated Water and Sediment

There are several ways (exposure pathways) humans can be exposed to PCBs in water and sediment. Evaluation of the resultant human health risks in the Kalamazoo River and Portage Creek has been undertaken by the Michigan Department of Community Health (formerly the Michigan Department of Public Health).

PCBs in the river are almost entirely bound to sediment particles, and are not often found up in the water unless contaminated sediments have been disturbed and suspended in the water. Therefore, PCB concentrations in surface waters in the Area of Concern generally do not exceed levels at which increased health risks would be incurred. Skin contact with water in the Kalamazoo River is not expected to result in a notably increased health risk to humans. Even occasionally swallowing water from the River, as when falling out of a boat, should not put anyone at increased risk from PCBs.

Since most contaminated sediment remains too wet to become airborne, inhalation of airborne particles would not result in a significant amount of exposure to PCBs. Health risks attributable to this pathway are highly unlikely.

At this time there are no known sites in the Kalamazoo River (other than Superfund landfills which have been fenced off from the general public) where typical activities would provide sufficient skin contact with PCB-contaminated soil or sediments to result in increased health risks.

Ingestion of PCB-laden sediments is the pathway that could provide some increased health risk. There are a number of locations in the Area of Concern where sediment PCB concentrations greatly exceed known health risk Criteria and Values. The MDEQ Generic Clean-up Criteria in soils are 2,300 ppb (2.3 ppm) for residential use and 21,000 ppb (21 ppm) for industrial use. Agency for Toxic Substances and Disease Registry (ATSDR) Comparison Values for PCBs in soil are 40 ppb (0.04 ppm) for a pica child, chronic exposure, non-cancer health effects; 1,000 ppb (1 ppm) for a non-pica child, chronic exposure, non-cancer health effects; 10,000 ppb (10 ppm) for an adult, chronic exposure, non-cancer health effects; and 400 ppb (0.4 ppm) for a 1 in 1,000,000 increased cancer risk over a lifetime exposure.

The pivotal issue is whether or not river sediments could be ingested on a frequent enough basis, and in sufficient quantities to result in health risks from PCBs. MDCH has concluded that for most people there is no increased PCB-related health risk from activities like swimming in the Kalamazoo River or Portage Creek. However, sediment is very easily suspended in the water by swimmers, boats, wave runners and windy weather, and young children frequently swallow water while swimming. It is not conclusively known whether children who live or frequently recreate in areas behind impoundments (or other areas with sediment deposits) could be at risk from PCB-contaminated sediments. In consultation with the PAC, MDEQ and MDCH have undertaken a joint study to determine if PCB concentrations at known swimming areas are high enough that the ingestion pathway may be one of realistic concern. Results should be available in 1998.

In 1996 the Michigan Department of Community Health, in consultation with the Kalamazoo River Public Advisory Council, published this *Kalamazoo River Fishing and Recreation Guide*. This brochure explains how PCBs ended up in the river, and outlines the risks of eating fish and other wildlife from the Area of Concern. For those people who choose to eat fish from the Kalamazoo River, the guide details which fish are not safe to eat, and explains how to prepare fish from the Kalamazoo River to avoid as much PCB-containing tissue as possible. The guide also notes that certain recreational activities like boating are unlikely to put people at increased health risk from PCBs.

Human Fish Consumption

PCBs in the sediments accumulate and can “biomagnify” in the food web. Fish, being several links up the food chain, may have high concentrations of contaminants in their bodies. Older fish often have the highest concentrations. Federal and state fish consumption guidelines establish an action level of 2 mg/kg total PCBs in edible portions of fish tissue. PCB concentrations in fillets of fish from Portage Creek and the Kalamazoo River typically exceed this threshold.

The Michigan Department of Community Health has issued these fish consumption advisories for the Kalamazoo River and Portage Creek. All advisories are attributable to PCB concentrations in fish.

River Reach	Species	Fish Length	Advisory
Kalamazoo River from Battle Creek to Morrow Pond Dam	Carp	fish 6 inches and longer	Do Not Eat. No one should eat any fish in this category.
Kalamazoo River from Morrow Pond Dam to Allegan Dam, & Portage Creek below Monarch Mill Pond in Kalamazoo County	Carp, Catfish, Suckers	fish 6 inches and longer	Do Not Eat. No one should eat any fish in this category.
	Large/Smallmouth Bass	fish 14 inches to 30 inches	Do Not Eat. No one should eat any fish in this category.
	All other species	fish 6 inches and longer	General Population 1 Meal per Week; Women and Children Do Not Eat.*
Kalamazoo River below Allegan Dam	Carp, Catfish	fish 6 inches and longer	Do Not Eat. No one should eat any fish in this category.
	Large/Smallmouth Bass	fish 14 inches to 30 inches	General Population 1 Meal per Week; Women and Children Do Not Eat.*
	Northern Pike	fish 22 inches and longer	Do Not Eat. No one should eat any fish in this category.
	All other species	fish 6 inches and longer	Women and Children 1 Meal per Month

* No one should eat more than one meal per week of fish in this category. Nursing mothers, pregnant women, women who intend to have children, and children under age 15 should not eat any fish in this category.
Excerpted from the 1998 Michigan Fish Advisory.

A 1993 study of Kalamazoo River and Portage Creek carp revealed PCB concentrations of skinless fillets up to 17 mg/kg and 8.8 mg/kg, respectively. The average PCB concentration in carp upstream of Battle Creek was 0.08 mg/kg, and in Morrow Pond 0.61 mg/kg. Average PCB concentrations in carp fillets from areas downstream of paper companies ranged from 1.8 mg/kg in Lake Allegan to 7.6 mg/kg downstream of Allegan Dam. PCB concentrations in carp fillets were an order of magnitude higher for the entire 80 miles of river downstream of PRP facilities than they were at upstream locations.

In smallmouth bass fillets PCB concentrations were also elevated downstream of paper company facilities compared to upstream. The highest fillet PCB concentration, 5.8 mg/kg, was in a smallmouth bass

collected from Lake Allegan. In these 1993 studies 73% of Portage Creek carp and 75% of carp collected downstream of Morrow Pond Dam contained fillet PCB concentrations exceeding 2 mg/kg, the fish consumption action level.

The Michigan Department of Community Health has issued a special advisory, in effect since 1988, on fish consumption from all inland lakes and reservoirs because of mercury pollution. No one should eat more than one meal a week of rock bass, yellow perch, or crappie over 9 inches in length; bass, walleye, northern pike or muskellunge of any size. Women who are breast feeding, pregnant women, women who intend to have children, and children under age 15 should not eat more than one meal per month of the fish listed above.

Effects on Fish and Wildlife

Fish. PCBs have been documented to cause mortality and deformities, as well as adverse reproductive, developmental, physiological, biochemical, histological and immunological effects on fish. PCB concentrations in Kalamazoo River fish exceed threshold levels known to have many of these effects. Several studies in the AOC have revealed that several species of fish from Portage Creek and the Kalamazoo River contain whole body PCB concentrations often in excess of 10 mg/kg. In 1993 whole-body PCB concentrations in some carp from the Kalamazoo River exceeded 20 mg/kg. Research has shown that adverse effects, including egg and fry mortality, occur at egg total PCB concentrations greater than 2-3 mg/kg. These data indicate that PCB concentrations in Portage Creek and Kalamazoo River fish are sufficient to potentially cause adverse effects on fish viability.

Fish-eating Animals. Concentrations of PCBs in fish tissue from the Kalamazoo River and Portage Creek also exceed levels known to have adverse effects on birds and mink who eat fish. Whole-body PCB concentrations in fish were measured as part of the RI/FS in 1993, and typically exceeded threshold levels known to cause injury to piscivorous (fish-eating) wildlife.

Mink. In 1993 the Michigan Department of Natural Resources (MDNR) collected mink from five locations along the Kalamazoo River, two upstream of PCB sources and three downstream, and analyzed carcasses and livers for PCBs. PCB concentrations in mink collected upstream of Battle Creek ranged from 1.9-6.5 mg/kg in carcasses and 1.2-6.0 mg/kg in livers. PCB concentrations in mink collected downstream of the paper companies ranged from 5.2-16 mg/kg in carcasses and 7.5-52.0 mg/kg in livers. The approximate threshold at which whole-body PCBs in Kalamazoo River fish would cause injury to mink is 2.4 mg/kg.

Birds. Research on PCB concentrations in bird eggs have concluded that adverse effects occur in the range of 1-5 mg/kg, although inter-species differences in sensitivity are likely.

Several studies have been conducted on water fowl in the AOC. These studies revealed that mallards, wood ducks, a merganser, a Canada goose, and a blue-winged teal had accumulated PCBs in edible tissues. PCB concentrations of 700 mg/kg lipid were measured in a merganser at Morrow Pond. Lipid-normalized concentrations of PCBs measured in mallards, wood ducks, blue-winged teal, and a Canada goose ranged as high as 73, 36.6, 9.6 and 6.4 mg/kg lipid, respectively.

PCBs have been linked to bald eagle reproductive failures in the Allegan State Game Area. In the last decade bald eagles have once again begun nesting locally with one or two nests annually in the Game Area along the Kalamazoo River. Since 1993 at least one pair has annually produced eggs and initiated incubation. However there have been no young hatched. In 1994 a non-viable egg was collected from a nest in Ottawa Marsh by the U.S. Fish and Wildlife Service. The egg contained 102 mg/kg PCBs, 100 times greater than the lower adverse effects threshold.

In 1993 six great blue heron eggs were collected from Ottawa Marsh. PCB concentrations in these eggs ranged from 1.48 mg/kg to 44.38 mg/kg. These concentrations exceed known adverse effects levels.

Non-piscivorous raptors are also accumulating PCBs. PCB concentrations in great horned owl and red-tailed hawk eggs in 1993 and 1994 were also sufficiently high to potentially cause injury. PCB concentrations measured in two great horned owl eggs collected from the Allegan State Game Area were 15.94 and 90.8 mg/kg. A red-tailed hawk egg also collected from the Allegan State Game Area in 1993 contained 2.31 mg/kg PCB, and two eggs collected in 1994 contained 4.47 and 27.12 mg/kg.

Mice and Earthworms. A 1993 RI/FS study revealed that PCB concentrations were higher in the whole bodies of white-footed mice (*Peromyscus leucopus*) and earthworms collected from floodplains downstream of PRP paper facilities than in those collected in Battle Creek, upstream of the facilities. Upstream of PRP facilities PCBs were not detected in any of the mice or earthworms collected. Downstream of PRP facilities PCBs were detected in 70% to 100% of the mice collected at four locations, and 100% of the earthworms where floodplain soils are contaminated with PCBs. Concentrations ranged as high as 0.45 mg/kg in the mice, and 3.2 mg/kg in the earthworms.

PCBs accumulating in mice and earthworms can be transferred to their predators. White-footed mice predators along the Kalamazoo River include great horned owls and red-tailed hawks. Earthworm predators include songbirds, snakes and a variety of other wildlife.

Muskrat. In 1994 MDNR collected muskrat from several locations upstream and downstream of PCB sources in the Kalamazoo River. PCBs were not detected in the carcasses or livers of any of the muskrat from the Battle Creek location. At the locations downstream of the paper companies PCBs were detected in 23 of 24 carcasses in concentrations up to 8.4 mg/kg, and 23 of 23 livers in concentrations from 0.12 to 3.8 mg/kg. The maximum concentrations were detected in muskrat collected near the former Trowbridge impoundment. Muskrats are plant eaters and ingest significant amounts of river sediments while foraging for roots and other food in the river.

Resource Goals

The overall goal for contaminated sediment remediation is restoration of beneficial use impairments caused by contaminated sediments: fish consumption advisories, restrictions on dredging, impaired benthos, restrictions on body contact, impairment of fish and wildlife habitat, impairment of fish and wildlife populations, wildlife reproductive problems. Protection of public and ecological health are the most important criteria for remediation. Site re-use is a key criteria for remediation. No dams should be removed until sediments in associated impoundments are remediated for PCB contamination.

Specific Goals are:

- Reduce PCB availability to the biota within the watershed so that humans and wildlife can have unrestricted consumption without health effects.
- Protect human health related to PCB contamination and mercury contamination in fish by reducing exposure through educational efforts.
- Remediate contaminated sediments so that there are no reproductive or other negative health effects on wildlife or the benthos.
- Remediate contaminated sediments so that there are no restrictions on body contact with the river.
- Remediate contaminated sediments to meet fish and wildlife habitat management goals in the Kalamazoo River watershed.
- Reduce levels of PCBs in sediments to eliminate restrictions on disposal of dredged material.

Necessary Remedial Activities

Sediment Remediation

The PAC believes that the clean-up level used for PCB contaminated sediments should be the most stringent one applicable and protective of life in and along the river. A starting point should be the Ontario Ministry of Environment and Energy biologically-based sediment guideline for the lowest effect level of PCB concentration in sediments: 0.07 ppm. Site specific criteria can be developed that take into account bioavailability, initial concentration, susceptibility to erosion, potential for site re-use, and conformity to the Great Lakes Water Quality Agreement. Detection limits must be low enough to detect levels of PCBs injurious to life.

The Kalamazoo River Public Advisory Council has published a *Position Statement on the Clean-up and Protection of the Kalamazoo River*, and is actively seeking endorsements. To date a number of organizations, county and local governments, and state and federal elected representatives have endorsed this position statement. The recommendations included in the position statement are those in the recommended action table below.

The PAC is also planning educational events and materials to disseminate information on the contamination problem and the recommended actions to local governments, businesses and the general public.

ACTION: Conduct sediment remediation and associated activities (high priority).		
Task	Cost	Responsible Parties
Stop more PCBs from entering the river. Immediately devise and implement a plan to stop the release of PCBs to the River and tributaries from eroding banks and run-off from former land-based contaminated sludge dump sites. Accelerate the remediation at dump sites where work is already underway.	*	<ul style="list-style-type: none">• PRPs• MDEQ• USEPA
Conduct a study of erosional areas along the river and in sediments to determine the causes and extent of movement of PCBs downstream.	*	<ul style="list-style-type: none">• PRPs• MDEQ• USEPA
Prevent unnecessary delays in releasing new information about PCBs and other toxicants. Information from studies on the river should be released in a timely manner, in an understandable form, and to a broad array of audiences.	*	<ul style="list-style-type: none">• PRPs• MDEQ• USEPA
All research, planning and implementation decisions must be made with significant public input.	Costs not determined, however this component involves more of a	<ul style="list-style-type: none">• PRPs• MDEQ• USEPA

	commitment of will and time than it does money.	<ul style="list-style-type: none"> • PAC • KRPA
Strengthen the partnership between government, business, and the public.		<ul style="list-style-type: none"> • PAC
Begin immediately to develop a preliminary PCB remediation plan for the actual river channel.	*	<ul style="list-style-type: none"> • PRPs • MDEQ • USEPA
Implement an effective education program for public officials and the general public which includes presentations, workshops, displays, consultations and one-on-one interactions. An easily accessible electronic clearinghouse of information indexed in a user-friendly way must be established.	Not determined	<ul style="list-style-type: none"> • PRPs • MDEQ • USEPA • PAC • KRPA
Develop and implement an adequate long-term monitoring program for PCBs and other contaminants.	Not determined	<ul style="list-style-type: none"> • PRPs • MDEQ • USEPA • PAC • KRPA

Funding sources: *costs of contaminated sediments remediation will be determined as part of the Superfund process.

Public Health Strategies

Recognizing that unrestricted consumption of fish and other wildlife is a long-term proposition, the Kalamazoo River Public Advisory Council feels very strongly that, in the short-term, all people who eat fish taken from the Kalamazoo River should be aware of the health risks.

Current efforts to provide accurate consumption advisories include the Superfund programs of the MDEQ and the USEPA. Local programs include efforts of the MDEQ and MDCH to assess the fish in the river and issue consumption advisories, and the efforts of the Public Advisory Council, the MDNR and the MDCH to educate anglers on the advisories.

Additional measures are needed to adequately inform the public about the health risks associated with consuming fish, water fowl and possibly other wildlife from the Kalamazoo River and Portage Creek.

ACTION 1: Develop and implement programs to educate consumers of Kalamazoo River fish and other wildlife about the health risks (medium priority).		
Task	Cost	Stakeholders
Create easily understood graphics and written materials such as brochures that define which fish are unsafe to eat in which areas of the river.	Create graphics: 10 days @ \$55/day=\$550	<ul style="list-style-type: none"> • consumers of fish and other wildlife • bait shops • health departments • health care providers • Superfund PRPs
Develop methods of distributing information by using billboards, pamphlets, posters, bait shop handouts, and local media.		
Erect semi-permanent billboards at public access sites along the Kalamazoo River.	Erect billboards: 10 days @ \$55/day=\$550	
Arrange for printing a fish consumption advisory brochure for distribution in the watershed.	Printed materials, 3200 copies @ 75¢ ea=\$2400	
Work with the Michigan Department of Community Health to distribute fish consumption advisory information to local health care providers.	Other material and travel: \$1000	
Identify heavily used non-public access sites for placement of additional billboards.		

Funding sources: grants and Superfund PRPs.

ACTION 2: Develop and implement programs to increase knowledge of elected officials at all levels of fish consumption advisories and associated risks (medium priority).		
Task	Cost	Stakeholders
Develop mailing lists of elected officials for: townships, cities, counties, state, federal.	45 days @ \$55/day=\$2475	<ul style="list-style-type: none"> • local government officials
Gather information such as published research on health issues related to the fish consumption advisories.		
Put together information packets of available information for mailing.	materials/mailing=\$325	
Develop a schedule for mailing the information packets to each elected official on a continuing basis.	costs/mailing=\$600	

Funding sources: local units of government and grants.

ACTION 3: Test additional species at selected locations in the Kalamazoo River to determine if current advisories are necessary and adequate (medium priority).		
Task	Cost	Stakeholders
MDEQ conduct sampling.	not determined	• All stakeholder noted previously
MDCH determine consumption advisories as appropriate.	not determined	
Funding sources: MDEQ and MDCH		

ACTION 4: Continue support of Superfund activity as it relates to fish consumption advisories (medium priority).		
Task	Cost	Stakeholders
Not defined.	not determined	<ul style="list-style-type: none"> All stakeholders noted previously
Funding sources: not determined		

ACTION 5: Identify and investigate any areas not identified in the Superfund work that may be contributing substances causing fish consumption advisories (medium priority).		
Task	Cost	Stakeholders
Not defined.	not determined	<ul style="list-style-type: none"> All stakeholders noted previously
Funding sources: not determined		

ACTION 6: Develop and implement programs to increase local involvement in the Superfund process (medium priority).		
Task	Cost	Stakeholders
Not defined	not determined	<ul style="list-style-type: none"> All stakeholders noted previously
Funding sources: not determined		

HABITAT LOSS AND DEGRADATION

Resource Evaluation

Habitat loss and degradation is wholly or partially responsible for the following use impairments: degradation of fish and wildlife populations, degradation of the benthos and loss of fish and wildlife habitat.

MDEQ Surface Water Quality Division has conducted biosurveys of a number of streams in the Kalamazoo River watershed in the past few years. Aquatic habitat quality varies significantly throughout the watershed, with some areas having quite healthy habitat and animal and plant communities, while other areas are seriously degraded.

Kalamazoo River. A survey of the Kalamazoo River and several tributaries in Kalamazoo and Allegan counties was conducted in 1994. The biological quality at 3 sites on the main branch of the Kalamazoo River between Comstock and Plainwell was rated non-impaired based on the aquatic macroinvertebrate communities. However, growths of *Cladophora*, a green filamentous alga, were observed at D Avenue, downstream of the Kalamazoo WWTP. A few weeks prior to this sampling, the Kalamazoo WWTP reported daily violations of the 5 mg/L dissolved oxygen standard from D Avenue downstream to the Plainwell Dam. Total phosphorus concentrations at both Comstock (0.065 mg/L) and D Avenue (0.099 mg/L) were elevated compared to other sampling locations in the watershed and reference streams in this ecoregion. All other water quality parameters were within the normal ranges for streams in this ecoregion.

Lake Allegan is considered highly eutrophic, with total phosphorus concentrations averaging 114 ug/L in this study. This significantly exceeds the 30 ug/L recommended concentration for lakes and impoundments. Swan Creek and unknown sources on the Kalamazoo River between Comstock and D Avenue appear to be the sources of nutrients.

Gull Lake Outlet. Gull Lake Outlet, a second order warmwater stream, was sampled in 1986 and 1994. Both surveys indicated the stream to be high quality. Fish and macroinvertebrate communities were rated "acceptable". Habitat conditions were slightly impaired to non-impaired. Most water quality parameters were within the normal ranges for streams in this ecoregion. Nitrite (0.014 mg/L), nitrate-nitrite (0.142 mg/L), and ammonia (0.132 mg/L) were elevated on one sampling date in 1994 compared with a second sampling date and with other sites in the watershed.

Comstock Creek. Comstock Creek, also sampled in 1994, is a second order warmwater stream and the outlet of Campbell Lake. The area is still largely wetland, which has buffered the creek from impacts. The fish and macroinvertebrate communities were rated as non-impaired, and had a very diverse community of molluscs. The habitat was rated as slightly impaired. Ammonia concentrations, 0.96 mg/L, were elevated compared to other sampling stations in the tributaries of the lower Kalamazoo River watershed. All other water quality parameters were within normal ranges for streams in this ecoregion.

Portage Creek. Portage Creek is a first to third order coldwater stream, which flows into the Kalamazoo River in the city of Kalamazoo. A survey conducted in 1993 indicated that macroinvertebrate communities were moderately impaired, with the majority of taxa being those that are relatively tolerant of poor water quality and habitat. Designated uses for a coldwater fishery were being met, as indicated by a fish community containing greater than 1% salmonids, however, the physical habitat was rated as severely to moderately impaired.

Arsenic concentrations in water samples at two or four locations exceeded those typically found in streams in this ecoregion.

A variety of organic contaminants were detected in water and sediments of Portage Creek. Sources appeared to be contaminated groundwater venting to the river from WL Molding, the City of Portage DPS, and Plastic Engineering, as well as the Pharmacia & Upjohn discharge via outfall 001. These sources also appeared to be impacting the macroinvertebrate communities in Portage Creek.

A 1995 survey also indicated an impaired aquatic macroinvertebrate community immediately downstream of the Pharmacia & Upjohn outfall 001 discharge.

Allen Creek. This stream is a small first order coldwater stream originating west of Parchment and flowing for approximately one mile to the Kalamazoo River. Four fish surveys conducted in the 1980s documented impacts of dewatering and dredging in the headwaters from Westnedge Avenue to Allen Street by Kalamazoo Township in 1981, 1982 and 1984. These operations resulted in a reduction of the native Brook trout population by 97% from 1981 to 1984, and impacts to the macroinvertebrate communities because of heavy siltation. In 1984 MDNR Fisheries Division initiated a three year restocking program of brook trout; a 1987 survey indicated slow recovery.

A 1994 biosurvey indicated moderate impairment of the macroinvertebrate community, and habitat conditions were degraded. Allen Creek was not meeting the designated uses for coldwater fishery. No brook trout were collected, and heavy siltation was still very prevalent. All water quality parameters were within the normal ranges for streams in this ecoregion.

Cooper Creek. Cooper Creek, a first order coldwater stream, originates north of Parchment and flows along a very steep gradient in the Kalamazoo Nature Center to the Kalamazoo River. In a 1994 survey, biological quality was non-impaired based on the aquatic macroinvertebrate community. The creek was meeting the designated uses for coldwater fishery. Ninety-eight percent of the fish collected were salmonids, primarily brook trout. All water quality parameters were within the normal ranges for streams in this ecoregion.

Dumont Creek. Dumont Creek is a first order warmwater stream originating at Dumont Lake, flowing approximately 4 miles along a fairly steep gradient, to the Kalamazoo River. In a 1994 the macroinvertebrate community and habitat were rated as non-impaired. All water quality parameters were within the normal ranges for streams in this ecoregion.

Swan Creek. This is a third order warmwater stream from the outlet of Swan Lake to 109th Avenue. The stream then becomes a largely groundwater fed coldwater stream within the Kalamazoo State Game Area to the Kalamazoo River. A 1989 fish survey indicated recent declines in the trout fishery because of increasing sedimentation. A 1994 survey rated biological quality of Swan Creek severely impaired based on fish and macroinvertebrate communities. The designated uses for coldwater fishery were being met in the coldwater portion of Swan Creek (2.9% salmonids). Habitat conditions ranged from moderately impaired to slightly impaired. Many of the pool and riffle areas were affected by significant amounts of shifting sand. The loss of habitat appears to be attributable to the extensive sand bedload from eroding road crossings and forested areas.

Davis Creek. Based on a 1994 survey, aquatic habitat quality varied widely in the Davis Creek watershed.

In an unnamed tributary near Lexington Green Park habitat conditions were rated as severely impaired because of the regular dredging maintenance and industrial storm water discharges. Silt deposition was more than three feet deep, and a petroleum sheen was discharging from a storm sewer outfall. The aquatic macroinvertebrate community was rated as moderately impaired.

At Sprinkle Road habitat quality was rated as unimpaired and the macroinvertebrate community was slightly impaired. However, from Kilgore Road to the confluence of Davis Creek with the Kalamazoo

River habitat and macroinvertebrate communities were rated as moderately impaired. Fish community structure throughout the Davis Creek basin was rated as slightly impaired. The results of this survey suggest that there have been no improvements in water quality and the biological health of Davis Creek as compared to previous surveys in 1977, 1979 and 1985.

Chart Creek. The overall biological quality of the East Branch, West Branch and main branch of Chart Creek was rated as severely impaired to slightly impaired based on the assessment of the macroinvertebrate community and habitat conditions in 1993. Impairments were attributed to nutrient enrichment from nonpoint sources and discharges from Murco, Inc. Lack of suitable substrate was attributed to drain maintenance projects.

Species diversity in the West Branch and mainstem were good, and indicative of a cold water system. The fish community on the East Branch was severely degraded because of low oxygen, elevated ammonia and poor habitat.

Rabbit River. In 1989 an agricultural pesticide spray (endosulfan) on the Rabbit River west of 2nd Street near Wayland resulted in fish and macroinvertebrate kills. Brown trout and other fish were severely impacted for more than 3 miles downstream. Macroinvertebrate communities were severely impacted for more than 10 miles downstream. Biosurveys conducted in 1989 and 1990 to assess impacts and recovery from the pesticide discharge indicated that macroinvertebrate communities had substantially recovered by the following year. Brown trout populations were still depleted but recovering. These biosurveys also indicated that habitat and biological communities in the Rabbit River were significantly degraded because of agricultural activities apart from the pesticide spray, primarily erosion and sedimentation from runoff and cattle access, and river channelization. River quality did not appear to be affected by permitted point source discharges from Dean Foods and Northbrook Mobile Home Park Estates.

In 1993 another biosurvey of this stretch of the Rabbit River indicated further recovery of stream communities from the pesticide spray. However, overall biological and habitat integrity of the upper Rabbit River was still considered poor. Fish communities of Green Lake outlet and Miller Creek were evaluated as slightly impaired. Community structure in both tributaries was considered typical of first to second order warm water systems.

Red Run Drain Watershed. The Red Run Drain system forms the headwaters of the Little Rabbit River. Based on a 1991 survey, the overall biological quality in the Red Run Drain, Dorr/Byron Drain and near the confluence of the Red Run Drain with the Little Rabbit River was assessed as moderately to severely impaired. Impairments appeared to result from nonpoint source farming practices. Little or no buffer areas existed between active fields and stream banks, and significant sedimentation has resulted in degraded habitat quality. Total phosphorus concentrations were higher than normal for streams in this area of Allegan County, ranging from 0.127 to 0.43 mg/L in the Red Run Drain and Byron/Dorr Drain.

The Long Point Bird Observatory Marsh Monitoring Program for marsh birds and amphibians in the Great Lakes Basin has included sites in the Kalamazoo River AOC since 1995. The program relies on local volunteers to conduct regular monitoring. Overall in the Great Lakes fewer birds and amphibians were found in Areas of Concern than in non-Areas of Concern. Long Point Bird Observatory staff are compiling "State of Their Environment" reports for each of the 43 AOCs addressing indices of marsh quality using birds and amphibians.

The Southwest Michigan Land Conservancy serves the 9 county region of southwest Michigan by acquiring and protecting natural areas, historic sites and open spaces through gifts and purchases; providing programs and sites for outdoor recreation, nature study and the appreciation of history; and assisting individuals and organizations who want to protect important land.

Resource Goals

The overall goal for habitat is restoration of beneficial use impairments caused by habitat degradation: loss of fish and wildlife habitat, degraded fish populations, degradation of benthos, degradation of aesthetics. The Kalamazoo River and its tributaries should provide suitable habitat to sustain populations of native fish and aquatic life.

Specific goals related to habitat quality include:

- Restore habitat for fish and wildlife in the Kalamazoo River watershed so that management goals can be met.
- Reduce populations of undesirable exotic species and prevent introductions of new ones into the Kalamazoo River to restore and protect desirable native species.
- Reduce erosion to the river and its tributaries so that sedimentation is not impacting benthic life.
- Mitigate the effects of impoundments on oxygen levels.

Necessary Remedial Activities

ACTION 1: Identify nonpoint and point sources that are impacting habitat quality (high priority).		
Task	Cost	Stakeholders
Survey the Kalamazoo River and tributaries to determine areas of erosion and other discharges.	not determined	<ul style="list-style-type: none"> • MDNR/MDEQ

Funding sources: County Road Commissions, County Drain Commissioners, MDNR/MDEQ grants, private grants, USEPA grants

ACTION 2: Develop a plan to determine if existing habitat is adequate to meet the goals (medium priority).		
Task	Cost	Stakeholders
Conduct water quality surveys.	not determined	<ul style="list-style-type: none"> • users of the river and its tributaries • planning, zoning & elected boards • developers • agricultural community • homeowners • MDEQ/MDNR
Conduct fish and aquatic life surveys at selected locations.	not determined	
Assess habitat damage and determine causes.	not determined	
Disseminate findings to planning and zoning officials in the watershed for damage associated with land.	Mailing to officials, 300 @ \$3 ea.= \$900	
Distribute model land use ordinances, i.e. Tip of the Mitt model, to all planning, zoning, and local elected boards in the watershed.	120 copies @ \$10 ea= \$1200	
Support legislation which increases or preserves water quality and oppose legislation which decreases water quality.		

Funding sources: MDNR, MDEQ, local governments, USEPA and private grants

ACTION 3: Develop a plan to determine what is degrading habitat in those areas that are inadequate to meet the goals (medium priority).		
Task	Cost	Stakeholders
Not determined	not determined	

Funding sources: not determined

ACTION 4: Develop a plan to measure existing habitat in the Kalamazoo River and tributaries (medium priority).		
Task	Cost	Stakeholders
Not determined	not determined	not determined

Funding sources: not determined

ACTION 5: Develop a plan to evaluate aquatic species other than fish (low priority).		
Task	Cost	Stakeholders
Not determined	not determined	not determined

Funding sources: not determined

ACTION 6: Support Superfund Project activities as they pertain to fish and aquatic life (low priority).		
Task	Cost	Stakeholders
Not determined	not determined	not determined

Funding sources: not determined

NONPOINT SOURCE POLLUTION

Resource Evaluation

Storm water runoff and erosion from urban and agricultural areas contributes significantly to water quality problems. In the Kalamazoo River AOC nonpoint source pollution is partially responsible for 5 of the 8 beneficial use impairments: degradation of fish and wildlife populations, degradation of the benthos, restrictions on body contact, loss of fish and wildlife habitat, and degradation of aesthetics.

Nonpoint source pollution is intermittent and usually occurs as the result of precipitation when water moving over the surface picks up pollutants and carries them into surface waters. Runoff volume may increase from 5-10% in a natural watershed to as much as 90-95% in a fully urbanized watershed where impervious surfaces dominate. Soil from construction sites, industrial pollutants, road salts and sands, motor oils and fuels, pet waste, and other pollutants are washed into streams, lakes and rivers either directly or via storm sewer systems.

In agricultural areas, mismanagement of livestock and livestock waste can introduce high levels of nutrients, soil and fecal pathogens to surface waters. Pesticides, fertilizers and soils can also be carried from croplands into surface waters via storm water runoff.

Nonpoint source contaminants have been specifically identified as contributing to resource degradation by the following MDEQ biosurveys. Streams in *italics* are upstream of the AOC.

Stream	Year of Survey	Causes/Contaminants	Sources
Rabbit River	1990	erosion, pesticides	agricultural
Red Run Drain, Dorr and Byron Drain, Little Rabbit River	1991	erosion, nutrients	agricultural
Kalamazoo River	1994	erosion, nutrients, toxics	urban/industrial, WWTP, agricultural
Gull Lake Outlet	1994	erosion, nutrients	agricultural
Comstock Creek	1994	erosion, nutrients	lake management agricultural
Allen Creek	1994	erosion	dewatering, dredging
Dumont Creek	1994	erosion	agriculture
Lake Allegan agriculture	1994	nutrients	
Swan Creek	1994	erosion	urban/industrial road crossing
Portage Creek	1994	erosion, toxics	urban/industrial
Chart Creek industrial	1994	nutrients	
Rabbit River	1993	erosion	agricultural
Davis Creek	1994	erosion, petroleum nutrients, metals	urban/industrial
<i>South Branch of the Kalamazoo River</i>	1994	erosion petroleum	damming commercial
<i>Talmadge Creek</i>	1994	nutrients, lawn clippings	residential
<i>Wilder Creek</i> agricultural	1994	nutrients	
<i>Rice Creek</i>	1994	erosion, nutrients	agricultural

Runoff from contaminated land-based sites where the quality of soil or groundwater has been degraded below established standards may also introduce contaminants into surface waters. These sites come either under the jurisdiction of federal Superfund program, or under Part 201 of the Natural Resources and Environmental Protection Act, Public Act 451 of 1994, as amended. There are six Superfund sites in the watershed: Allied Paper, Inc./Portage Creek/Kalamazoo River (see *PCB Contamination* Chapter); Auto-Ion Chemicals, Inc.; K and L Avenue Landfill; Michigan Disposal (Cork Street Landfill); Rockwell International Corp; and Roto-Finish Co., Inc. As of 1994, there were 84 “Act 201” sites in Kalamazoo County and 41 in Allegan County. As of 1995 there were also 143 and 49, respectively, identified leaking underground storage tanks in those counties. It is not known how many of these sites are introducing contaminants to surface waters; all certainly have the potential to pollute ground water.

A 1997 Kalamazoo College senior thesis by David Andrus identified 19 erosional sites on the Kalamazoo River between Augusta and Otsego. The study identified, located, described and rated active sites of stream bank erosion and sediment delivery.

Programs to address storm water discharges through municipal storm sewer systems include the storm water NPDES permitting program administered by MDEQ, municipal storm water management plans, and county drain commissioner activities. Currently there are 93 industrial facilities in the AOC with coverage under the Michigan General Storm Water Permit (see appendix A). None of the municipalities in the AOC have populations greater than 100,000; therefore, none are required to have municipal storm water permits at this time. However, under the federal Phase II storm water regulations the municipalities of Kalamazoo, Parchment, and Portage (and possibly adjacent urbanized areas), and Kalamazoo and Allegan counties will be subject to regulation. In anticipation of these regulations a number of municipal entities including Kalamazoo County, the cities and villages of Kalamazoo, Portage, Parchment, and Comstock, Kalamazoo Township, and other agencies and organizations have formed a committee to investigate cooperative storm water management efforts.

Section 319 of the federal Clean Water Act provides funding for addressing nonpoint source problems. 319 grants to local agencies or organizations are awarded and administered by the Surface Water Quality Division of the MDEQ. There are currently two on-going 319 watershed projects in the Kalamazoo River AOC:

- The Allegan County Soil & Water Conservation District is in the third year of the Little Rabbit River watershed project. This project is focused on addressing livestock waste management practices.
- The Davis Creek watershed 319 project, being carried out by Kalamazoo River Partners under contract with the Kalamazoo County Soil Conservation District, is focused on urban best management practices. Efforts are concentrated on working in industrial and residential areas, as well as coordinating efforts among municipal governments involved in nonpoint source related activities.

Under a separate federal grant for the Areas of Concern Program, Western Michigan University Geographical Information Systems (GIS) Research Laboratory has created a GIS database of the types and amounts of land uses, as related to impervious surfaces, in the Davis Creek watershed so that storm water management planning can be done.

In 1995, in a settlement for environmental violations, Pharmacia & Upjohn, Inc. provided \$225,000 to the Kalamazoo Foundation Sustainable Community Watershed Fund. This fund is intended for identification and quantification of pollutant loadings from storm water runoff and other nonpoint sources discharges, as well as for other watershed management issues.

The Kalamazoo County Environmental Health Bureau is involved in several areas of nonpoint source controls: onsite wastewater treatment systems, septage waste hauling, monitoring residential wells, providing a Business Environmental Education Assistance Program, and operating a household hazardous waste program.

Michigan State University Extension Service provides information and educational materials and workshops on a variety of issues related to water quality and watershed management.

The River Partners Program (RPP) of the Forum for Kalamazoo County was initiated in 1990 to protect, improve and develop the Kalamazoo River. The Nonpoint Source Advisory Committee of the River Partners Program convenes water quality professionals from a variety of agencies and organizations seeking to address nonpoint source pollution. The Nonpoint Source Advisory Committee conducted tributary water quality testing which identified Davis Creek as the most impaired tributary to the Kalamazoo River in Kalamazoo County. The Davis Creek watershed program, including the watershed 319 project, is a result of these efforts. In 1996 the River Partners Program, in conjunction with the Kalamazoo Gazette, published a watershed landowner guide. RPP also works with local citizens in several river and creek cleanups each year.

The Kalamazoo County Road Commission contracted with United Environmental Technologies, Inc. to conduct a study entitled “Kalamazoo River Basin Primary Roads Storm Water Mitigation Study”. 115 sites were inventoried to determine which roadway characteristics are most critical when determining impacts from storm water runoff, and to prioritize sites.

Resource Goals

The overall goal is to restore beneficial use impairments caused by nonpoint source pollution of surface waters: degradation of fish and wildlife populations, degradation of benthos, degradation of aesthetics, loss of fish and wildlife habitat.

Specific goals include:

- Reduce nonpoint source pollution to the main river and tributaries within the watershed so that sedimentation is not impacting the benthic life.
- Control nonpoint source pollution in the Kalamazoo River so that fish and wildlife habitat management goals can be met.
- Reduce nutrient input to prevent eutrophication of impoundments within the watershed.
- Continue regulatory and nonregulatory pollution prevention, and spill prevention/control activities so that pollutants that could cause concern for body contact do not enter the river in storm water.
- Continue regulatory and nonregulatory pollution prevention, land use, and spill prevention/control activities so that pollutants within the watershed that could cause degradation of aesthetics will not enter the ecosystem.

Necessary Remedial Activities

ACTION 1: Develop educational and regulatory programs to alleviate soil erosion problems (high priority).		
Task	Cost	Partners
Identify specific areas where soil erosion has or is causing problems.	not determined	<ul style="list-style-type: none"> • MDEQ • Natural Resources Conservation Service • MSU Extension Service • Home Builders Association • County Drain Commissions • Agricultural community • Road Commissions
Identify and educate local government officials on soil erosion controls and requirements.	not determined	
Educate site planners, builders, engineers, and construction firms regarding soil erosion issues at the Kalamazoo Home Builders Show as well as other venues.	not determined	
Contact all local planning and zoning commissioners and review current rules and regulations. Develop and implement model ordinances to assist these various commissions and communities.	not determined	
Conduct field tour of sites identified in the first action to educate people regarding problems and impacts.	not determined	
Educate county road commissioners about sediment and erosion impacts from road ditchings, crossings, repairs, bridges and road building.	not determined	
Encourage best management practices in the agricultural community for control of nonpoint source pollution.	not determined	
Identify model soil erosion control areas and educate others.	not determined	

Funding sources: not determined

ACTION 2: Eliminate sources of fecal pathogens to the Kalamazoo River and it's tributaries (medium priority).		
Task	Cost	Partners
Determine areas of high septic tank density to assess potential bacterial impacts.	not determined	<ul style="list-style-type: none"> • Kalamazoo and Allegan co. health departments
Identify and alleviate impacts from animal feed lots.	not determined	<ul style="list-style-type: none"> • NRCS • MSU CES
Develop educational programs to inform the public about not attracting or feeding water fowl.	not determined	<ul style="list-style-type: none"> • Local Parks

Funding sources: not determined

ACTION 3: Reduce inputs of pesticides to the Kalamazoo River and it's tributaries (medium priority).		
Task	Cost	Partners
Identify and alleviate adverse impacts from pesticide use through educational programs such as license training.	not determined	<ul style="list-style-type: none"> • NRCS • MSU CES • MDA

Funding sources: not determined

ACTION 4: Reduce inputs of pollutants to the Kalamazoo River and it's tributaries via municipal storm sewer systems (medium priority).		
Task	Cost	Partners
Identify storm water outfalls to the Kalamazoo River.	not determined	<ul style="list-style-type: none"> • Municipalities with storm sewer systems
Work with local governments on identifying and mapping storm sewer systems. Use GIS to accomplish this action.		
Develop and implement educational programs regarding actions and disposal practices that impact storm water runoff.	not determined	
Develop model ordinances and programs to promote consistent use and enforcement of storm sewer regulations and requirements.	not determined	<ul style="list-style-type: none"> • Municipalities with storm sewer systems • county drain commissioners
Work with local officials to identify funding sources and to educate the general public on storm water impacts.	not determined	
Identify volunteer lists to assist in implementing specific actions and to assist in mapping.	not determined	

Funding sources: not determined

ACTION 5: Reduce inputs of nutrients to the Kalamazoo River and it's tributaries (low priority).		
Task	Cost	Partners
Identify and alleviate impacts from agricultural fertilizers.	not determined	<ul style="list-style-type: none"> • NRCS • MSU CES
Develop educational programs directed toward homeowners and lawn service customers to reduce fertilizer applications.	not determined	

Funding sources: not determined

LAND USE

Resource Evaluation

All of the water quality use impairments in the Kalamazoo River AOC have resulted from how we historically and currently use land. Urban and suburban development is preempting farmland in the Kalamazoo River basin. Agriculture is still the primary land use in the watershed.

The GIS Research Center at Western Michigan University is facilitating land use management efforts in the Kalamazoo River watershed. Development of a 1996 land-use GIS system is and will be a pivotal component to land management planning. WMU's Groundwater Education in Michigan program has initiated some land use planning efforts with local townships.

The Four Township Water Resources Council, a coalition of township officials and citizens from Ross and Richland townships in Kalamazoo County and Prairieville and Barry townships in Barry County, are pursuing land use strategies that will preserve open spaces and protect water quality.

Necessary Remedial Actions

ACTION 1: Develop and implement specific action plans for educating elected or appointed officials, including local boards, commissions, and staff (high priority).		
Task	Cost	Partners
Compile and organize appropriate background and educational materials.	not determined	<ul style="list-style-type: none"> not determined
Package the materials in a user-friendly form and make them pertinent to the Kalamazoo River watershed.	not determined	
Gather information from land-use planning experts.	not determined	
Enlist help of land use planning consultants.	not determined	
Recruit graduate students to assist with the project.	not determined	
Brainstorm ideas about motivating government officials to take actions on land use issues.	no cost	
Request time on agendas of local board and commissions when land use educational materials are available.	no cost	
Recruit representatives from local boards and commissions to participate in training on land use. Incorporate field trips into training.	not determined	
Support other organizations and programs focused on land use.	not determined	

Funding sources: not determined

ACTION 2: Facilitate enactment of appropriate model ordinances, working with appropriate local decision-makers and the public (high priority).		
Task	Cost	Partners
Secure land-use maps and other pertinent land use information for specific jurisdictions in the Kalamazoo River watershed.	not determined	<ul style="list-style-type: none"> not determined
Provide technical assistance to boards and commissions in enacting model ordinances.	not determined	
Subtask		
Identify boards and commissions with responsibilities for land use related ordinances.	not determined	
Identify members who might be advocates.	not determined	
Attend appropriate meetings.	not determined	
Provide materials.	not determined	
Maintain regular communications during the enactment process.	not determined	

Funding sources: not determined

ACTION 3: Emphasize low-impact land use planning for the Kalamazoo River corridor (high priority).		
Task	Cost	Partners
Maximize compatible riparian uses that protect the unique characteristics of the river and it's tributaries.	not determined	<ul style="list-style-type: none"> not determined
Provide special protection for high quality natural.		

Funding sources: not determined

ACTION 4: Remediate and acquire riparian habitats (medium priority).		
Task	Cost	Partners
Remediate degraded sites.	not determined	
Develop strategies for retaining and acquiring land in the public and non-profit and non-profit domains on the river corridor and it's tributaries.	not determined	

Funding sources: not determined

ACTION 5: Initiate informational and educational programs (medium priority).		
Task	Cost	Partners
Seek funding for education and other land use related activities.	not determined	<ul style="list-style-type: none"> not determined
Develop central access points for education and information materials.	not determined	
Participate in community events appropriate for providing land use information to the public.	not determined	
Develop a display of land use patterns in the watershed.	not determined	
Develop and disseminate land-use educational materials to teachers and schools.	not determined	

Funding sources: not determined

Summary of High Priority Action Items

The following are the high priority activities necessary for eliminating or minimizing water quality use impairments in the Kalamazoo River Area of Concern, as determined by the Public Advisory Council. The Public Advisory Council is currently developing strategies for implementation of these actions.

Impairment Category	Use Impairments	High Priority Action Plans For a list of the subtasks in each action plan, see the impairment category chapter.
<i>PCB Contamination</i>	<ul style="list-style-type: none"> • Restrictions on fish consumption • Degraded fish and wildlife populations • Animal reproductive problems • Degradation of the benthos • Restrictions on dredging activities • Restrictions on body contact 	<ul style="list-style-type: none"> • Conduct sediment remediation and associated activities.
<i>Habitat Loss and Degradation</i>	<ul style="list-style-type: none"> • Degradation of fish and wildlife populations • Degradation of the benthos • Loss of fish and wildlife habitat 	<ul style="list-style-type: none"> • Identify nonpoint and point sources that are impacting habitat quality.
<i>Nonpoint Source Pollution</i>	<ul style="list-style-type: none"> • Degradation of fish and wildlife populations • Degradation of the benthos • Loss of fish and wildlife habitat • Restrictions on body contact • Degradation of aesthetics 	<ul style="list-style-type: none"> • Develop educational and regulatory programs to alleviate soil erosion problems.
<i>Land Use</i>	<ul style="list-style-type: none"> • Degradation of fish and wildlife populations • Degradation of the benthos • Loss of fish and wildlife habitat • Degradation of aesthetics • Restrictions on body contact 	<ul style="list-style-type: none"> • Develop and implement specific action plans for educating elected or appointed officials, including local boards, commissions and staff about land use planning. • Facilitate enactment of appropriate model ordinances, working with appropriate local decision-makers and the public. • Emphasize low-impact land-use planning for the Kalamazoo River corridor.

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Appendix A. National Pollutant Discharge Elimination System (NPDES) permits issued to facilities in the Kalamazoo River Area of Concern, as of May 1997.

Individual Permits. These permits are typically for process wastes, and contain effluent limits, monitoring and reporting requirements, and sometimes other conditions that are specific to individual facilities.

Permittee	Location	County	Receiving Waters
A.M. Todd	Kalamazoo	Kalamazoo	Kalamazoo River via storm sewers
Allegan Metal Finishing	Allegan	Allegan	Kalamazoo River
Allegan WWTP	Allegan	Allegan	Kalamazoo River
Ano-Kal	Plainwell	Allegan	Kalamazoo River via Nelson Gilkey Drain
Benchmark Coaters	Otsego	Allegan	Kalamazoo River
Bruce Alan Enterprises	Hamilton	Allegan	Red Run Drain
C. Stoddard & Sons	Wayland	Allegan	Rabbit River via Hilbert Drain
Checker Motors Corporation	Kalamazoo	Kalamazoo	Kalamazoo River via storm sewers
Crystal Flash LP-Kalamazoo	Kalamazoo	Kalamazoo	Monarch Mill Pond
Culligan-Saugatuck	Saugatuck	Allegan	Kalamazoo Lake via storm sewers
Dean Foods	Wayland	Allegan	Rabbit River
Fennville WWSL	Fennville	Allegan	Mann Creek-Severensen Drain
General Signal-Galesburg	Galesburg	Kalamazoo	Morrow Lake
Georgia-Pacific-Kalamazoo	Kalamazoo	Kalamazoo	Kalamazoo River
Gun Lake WWTP	Shelbyville	Barry	Gun River
Hamilton Farm Bureau Coop	Hamilton	Allegan	Rabbit River via Sweets Creek
Hamilton Public Schools WWSL	Hamilton	Allegan	Rabbit River via Lohman Drain
Hanson Management Co.	Kalamazoo	Kalamazoo	Kalamazoo River via Arcadia Creek
Hopkins WWSL	Hopkins	Allegan	Bear Creek-Rabbit & Kalamazoo rivers
Hudsonville Creamery	Burnips	Allegan	Little Rabbit River via Ebmeyer Co. Drain
James River KVP-Parchment	Parchment	Kalamazoo	Kalamazoo River
James River-Paperboard Pkg.	Kalamazoo	Kalamazoo	Kalamazoo River
Kalamazoo Creamery Company	Kalamazoo	Kalamazoo	Portage Creek via storm sewers
Kalamazoo Enterprises	Kalamazoo	Kalamazoo	Kalamazoo River via storm sewers
Kalamazoo Lk Wat & SA WWTP	Saugatuck	Allegan	Kalamazoo River
Kalamazoo WWTP	Kalamazoo	Kalamazoo	Kalamazoo River
Kalamazoo-Morrow Lake	Kalamazoo	Kalamazoo	Morrow Lake and Kalamazoo River
Kruger Commodities	Hamilton	Allegan	Kalamazoo River
Lakeside Refining Company	Kalamazoo	Kalamazoo	Davis Creek
Leighton Twp-Green Lake WWSL	Caledonia	Allegan	Green Lake Creek via Tollenaar Drain
Menasha Corporation	Otsego	Allegan	Kalamazoo River
Mitech Electronics Corporation	Otsego	Allegan	Kalamazoo River via Bauman Drain
Murco Inc.	Plainwell	Allegan	North Branch of Chart Creek
Organics-Lagrange Inc.	Northbrook	Allegan	North Fork of Black River via storm sewers
Otsego WWTP	Otsego	Allegan	Kalamazoo River
Parker Hannifin-Brass Prod. Div.	Otsego	Allegan	Braughman Drain
Parker Hannifin-Pump/Motor Div.	Otsego	Allegan	Braughman Drain
Perrigo Co.-Plant No. 1	Allegan	Allegan	Kalamazoo River
Perrigo Co.-Plants No. 4 & 5	Allegan	Allegan	Kalamazoo River and Rossman Creek
Pharmacia & Upjohn-Portage Rd.	Kalamazoo	Kalamazoo	Portage Creek and Austin Lake
Plainwell WWTP	Plainwell	Allegan	Kalamazoo River
Plastic Engineering Corp.	Portage	Kalamazoo	Portage Creek
Preferred Plastics Production	Plainwell	Allegan	Kalamazoo River
Rich Products Corporation	Saugatuck	Allegan	Kalamazoo River via storm sewers
Rock-Tenn Co.	Otsego	Allegan	Kalamazoo River

Simpson Plainwell Paper Co.	Plainwell	Allegan	Kalamazoo River
Strebor Inc.	Kalamazoo	Kalamazoo	Portage Creek via storm sewers
Taplin Enterprises	Kalamazoo	Kalamazoo	Arcadia Creek
Truheat Corp.	Allegan	Allegan	Kalamazoo River via Fields Brook
W-L Molding Co.-Portage	Portage	Kalamazoo	Portage Creek via pipeline
WMU-Power Plant	Kalamazoo	Kalamazoo	Arcadia Creek
Wolverine Power Supply	Burnips	Allegan	Red Run Drain via Green Co. Ext. Drain

General Permits. These discharge permits specify certain conditions under which a facility must discharge, but do not include effluent limits, or monitoring and reporting requirements specific to the individual facility.

BTEX (benzene, toluene, ethylbenzene, xylenes), typically discharges from groundwater clean-up systems

Permittee	Location	County	Receiving Waters
Allegan CRC-Pullman	Pullman	Allegan	Scott Creek Drain
Amoco Oil Co.-Dorr	Dorr	Allegan	Red Run Drain via storm sewers
Barry Co. Telephone Co.	Delton	Barry	Crooked Lake via adjacent wetlands
Boeve Oil Co.-Allegan	Allegan	Allegan	Kalamazoo River via storm sewers
Clark Oil Co.-Kalamazoo	Kalamazoo	Kalamazoo	Arcadia Creek
Clark Plainwell #2009	Plainwell	Allegan	Kalamazoo River via storm sewers
Davis Oil Co.-Galesburg	Galesburg	Kalamazoo	Kalamazoo River via storm sewers
Emro-Kalamazoo-Riverview	Kalamazoo	Kalamazoo	Kalamazoo River via storm sewers
Geib Oil Co.-Plainwell	Plainwell	Allegan	Kalamazoo River via storm sewers
Geib Oil Co.-Plainwell	Plainwell	Allegan	Kalamazoo River via storm sewers
Hopkins PS	Hopkins	Allegan	Bear Creek via storm sewers
Rick King's Campus Total	Kalamazoo	Kalamazoo	Arcadia Creek via storm sewers
Star Truck Rental-Kalamazoo	Kalamazoo	Kalamazoo	Kalamazoo River
Welsh Oil Co.-Vicksburg	Vicksburg	Kalamazoo	Portage Creek

Noncontact Cooling Water

Permittee	Location	County	Receiving Waters
Glassmaster Controls-Kalamazoo	Kalamazoo	Kalamazoo	Kalamazoo River
Hercules Inc.-Kalamazoo Plant	Parchment	Kalamazoo	Kalamazoo River
Kalamazoo Center Holdings Inc.	Kalamazoo	Kalamazoo	Arcadia Creek
Kalamazoo Nature Center	Kalamazoo	Kalamazoo	Collier Creek (Trout Run)
Kalamazoo Public Services Dept.	Kalamazoo	Kalamazoo	Portage Creek
Parker Abex NWL Aerospace	Kalamazoo	Kalamazoo	Kalamazoo River via storm sewers
Swift-Eckrich-Kalamazoo	Kalamazoo	Kalamazoo	Portage Creek
Truheat Corp.	Allegan	Allegan	Fields Brook
Wells Aluminum Corp.	Kalamazoo	Kalamazoo	Kalamazoo River via Travis Creek

Secondary Treatment

Permittee	Location	County	Receiving Waters
Kalamazoo Lake WWTP	Saugatuck	Allegan	Kalamazoo River

Sewage Lagoon Systems

Permittee	Location	County	Receiving Waters
Moline WWSL	Caledonia	Allegan	Green Lake Creek

Hydrostatic Pressure Test Water

Permittee	Location	County	Receiving Waters
R.L. Coolsaet Const.-Menasha	Otsego	Allegan	Kalamazoo River
Westside Pipeline-Kalamazoo	Kalamazoo	Kalamazoo	Kalamazoo River

Storm Water

Permittee	Location	County	Receiving Waters
A & M Machine Shop-Kalamazoo	Kalamazoo	Kalamazoo	Kalamazoo River
Ace Trucking	Moline	Allegan	Bisbee Drain
Acro Inc.-Fennville	Fennville	Allegan	Mann Creek
Alvan Motor Freight-Kalamazoo	Kalamazoo	Kalamazoo	Davis Creek
Azon USA, Inc.	Kalamazoo	Kalamazoo	Kalamazoo River
Beloit Wheeler Div.-Kalamazoo	Kalamazoo	Kalamazoo	Kalamazoo River
Benchmark Coaters	Otsego	Allegan	Kalamazoo River
Benteler Industries	Galesburg	Kalamazoo	Kalamazoo River
BFI Kalamazoo MRF	Kalamazoo	Kalamazoo	Kalamazoo River
BFI Kalamazoo Transfer-E. Cork	Kalamazoo	Kalamazoo	Kalamazoo River
BFI Waste Sys.-E. North	Kalamazoo	Kalamazoo	Kalamazoo River
Borroughs Corp.-Kalamazoo	Kalamazoo	Kalamazoo	Kalamazoo River
Broward Marine	Saugatuck	Allegan	Kalamazoo River
Bunting Bearings Corp.	Kalamazoo	Kalamazoo	Davis Creek
Central Transport-Kalamazoo	Kalamazoo	Kalamazoo	Kalamazoo River
Checker Motors	Kalamazoo	Kalamazoo	Kalamazoo River
Consolid Rail Corp.-Kalamazoo	Kalamazoo	Kalamazoo	Kalamazoo River
Consumers Concrete	Kalamazoo	Kalamazoo	Kalamazoo River
Crescent Metal Products	Allegan	Allegan	Maplewood Drain
Crown Paper-Parchment	Parchment	Kalamazoo	Kalamazoo River
Dean Foods	Wayland	Allegan	Rabbit River
Delrod Sales Corp.	Kalamazoo	Kalamazoo	Kalamazoo River via storm sewers
Douglas Marine Corp.	Douglas	Allegan	Kalamazoo River
Earl McLeod	Otsego	Allegan	Kalamazoo River
Eaton Reman Core Center	Kalamazoo	Kalamazoo	Kalamazoo River via storm sewers
Flint Ink Corp.-Kalamazoo	Kalamazoo	Kalamazoo	Zantman Drain
General Chemical Corp.-Henley	Kalamazoo	Kalamazoo	Kalamazoo River
GM Boc-Kalamazoo	Kalamazoo	Kalamazoo	Davis Creek and Kalamazoo River
Green Bay Packaging-N. Burdick	Kalamazoo	Kalamazoo	Kalamazoo River
Green Bay Packaging-S. Plt.	Kalamazoo	Kalamazoo	Kalamazoo River
Hammond Mach-Roto Finish	Kalamazoo	Kalamazoo	Kalamazoo River
Hammond-Roto-Finish-Otsego	Otsego	Allegan	Kalamazoo River
Haviland Enterprises-Kalamazoo	Kalamazoo	Kalamazoo	Kalamazoo River
Haworth Inc.-Allegan	Allegan	Allegan	Kalamazoo River
Haworth Inc.-Douglas	Douglas	Allegan	Kalamazoo River
Hercules Inc.-Kalamazoo Plant	Parchment	Kalamazoo	Kalamazoo River
Hilltop Auto and Salvage	Shelbyville	Allegan	Gun Creek
Indian Trails-Bus-Kalamazoo	Kalamazoo	Kalamazoo	Kalamazoo River
International Paper Co.	Kalamazoo	Kalamazoo	Davis Creek
INX International Ink Co.	Kalamazoo	Kalamazoo	Kalamazoo River
J.A. Richards Co.	Kalamazoo	Kalamazoo	Kalamazoo River via storm sewers
Jackson Iron and Metal	Kalamazoo	Kalamazoo	Kalamazoo River
James River Corp.-Epic	Parchment	Kalamazoo	Kalamazoo River
Kalamazoo-BC Intl Airport	Kalamazoo	Kalamazoo	Davis Creek
Kalamazoo Metal Finishers	Kalamazoo	Kalamazoo	Davis Creek
Kalamazoo Metal Recyclers	Kalamazoo	Kalamazoo	Kalamazoo River

Kalamazoo Scrap & Processing	Kalamazoo	Kalamazoo	Davis Creek
Kalamazoo Stamping-Glendenning	Kalamazoo	Kalamazoo	Kalamazoo River
Kalamazoo Stamping-Palmer Ave.	Kalamazoo	Kalamazoo	Kalamazoo River
Kalamazoo Transit System	Kalamazoo	Kalamazoo	Kalamazoo River
Koolant Coolers Inc.	Kalamazoo	Kalamazoo	Kalamazoo River
Kruger Commodities	Hamilton	Allegan	Kalamazoo River
KSM Ind. Scrap Processors	Kalamazoo	Kalamazoo	Kalamazoo River via storm sewers
KTS Industries Inc.	Kalamazoo	Kalamazoo	Kalamazoo River
Lake St. Used Auto Parts	Kalamazoo	Kalamazoo	Kalamazoo River via storm sewers
Mar-Bil Marine	Plainwell	Barry	Pine Lake
Menasha	Otsego	Allegan	Kalamazoo River
Michigan ANG-Augusta	Augusta	Kalamazoo	Eagle Lake
Michigan Fruit Cannery	Fennville	Allegan	Fennville Billings Drain
Murco	Plainwell	Allegan	North Branch of Chart Creek
Padgham Field-Allegan	Allegan	Allegan	Fields Brook
Paramount Tool Co., Inc.	Saugatuck	Allegan	unnamed tributary to Goshorn Creek
Parker Abex NWL Aerospace	Kalamazoo	Kalamazoo	Kalamazoo River and Davis Creek
Parker Hannifin-Brass Prod. Div.	Otsego	Allegan	Baughman Drain
Perrigo Co.-Plant No. 5	Allegan	Allegan	Kalamazoo River
Pharmacia & Upjohn Co.-Kilgore	Kalamazoo	Kalamazoo	Davis Creek
Pre-Con Corp.-Kalamazoo	Kalamazoo	Kalamazoo	Kalamazoo River
Precision Heat Treating	Kalamazoo	Kalamazoo	Kalamazoo River
Richland Auto Truck Salvage	Richland	Kalamazoo	Spring Brook
RPS-Kalamazoo	Kalamazoo	Kalamazoo	Davis Creek
Saugatuck Yacht Services	Saugatuck	Allegan	Kalamazoo River
Schafer Bakeries-Kalamazoo	Kalamazoo	Kalamazoo	Kalamazoo River
Schupan & Sons-Miller Road	Kalamazoo	Kalamazoo	Davis Creek
Schupan Aluminum-Olmstead Rd.	Kalamazoo	Kalamazoo	Davis Creek
Sebright Products-12th St.	Wayland	Allegan	Miller Creek
Sebright Products-Elm St.	Hopkins	Allegan	Bear Creek Drain
Sebright Products-N. Water	Hopkins	Allegan	Bear Creek Drain
Specialty Minerals-Plainwell	Plainwell	Allegan	Kalamazoo River
Statler Ready Mixed-4th Street	Kalamazoo	Kalamazoo	Kalamazoo River
Steves Auto Parts/Spring Valley	Kalamazoo	Kalamazoo	Davis Creek
Thompson-McCully Co.	Kalamazoo	Kalamazoo	Kalamazoo River
Tower Marine	Douglas	Allegan	Kalamazoo River
Truheat Corporation	Allegan	Allegan	Fields Brook
Union Camp Corp.-Kalamazoo	Kalamazoo	Kalamazoo	Davis Creek
USPS-Kalamazoo	Kalamazoo	Kalamazoo	Davis Creek
Waanders Concrete-Babylon Rd.	Allegan	Allegan	Kalamazoo River
Weller Auto Parts-Kalamazoo	Kalamazoo	Kalamazoo	Kalamazoo River
Wells Aluminum Corp.	Kalamazoo	Kalamazoo	Kalamazoo River via Travis Creek
West Shore Marine-Saugatuck	Saugatuck	Allegan	Kalamazoo River
Wright Coating-N. Pitcher	Kalamazoo	Kalamazoo	Kalamazoo River

Appendix B. Sources of Additional Information

- Kalamazoo River Area of Concern
Public Advisory Council
c/o Southwest Michigan Land Conservancy
8135 Cox's Drive
Portage, MI 49002
Phone: 616-324-1600
- Kalamazoo River Protection Association
P.O. Box 408
Allegan, MI 49010
Phone:
- Kalamazoo River Partners
c/o The Forum
217 Monroe
Kalamazoo, MI 49006
Phone: 616-337-7002
- Michigan Department of Environmental Quality
Plainwell District Office
1342 M-89 West, Suite B
Plainwell, MI 49080
Phone: 616-692-6970
- Waldo Library, Western Michigan University
Reports and other information available;
check normal holdings database
- Repositories of
Kalamazoo River Superfund Site documents:
Kalamazoo Public Library, Charles Ransom
Library (Plainwell), Allegan Public Library,
Waldo Library (WMU), Otsego District
Library, and Comstock Township Library
- Information on Great Lakes AOCs and other
Great Lakes Basin concerns/issues:
International Joint Commission
Great Lakes Regional Office
P.O. Box 32869
Detroit, MI 48232
Telephone: 313-226-2170
- Michigan Department of Natural Resources
Plainwell District Office
P.O. Box 355
Plainwell, MI 49080
Phone: 616-387-3791

Learn More About the Kalamazoo River and the Area of Concern

Pay the River a Visit. There are many public access sites on the Kalamazoo River at city, township, and county parks, as well as MDNR fishing sites, Fort Custer State Park, and the Allegan State Game Area. Private access sites include marinas and campgrounds. If you are looking for views of the River, there are dozens of bridges where you can get glimpses. There are also public access sites on some tributaries.

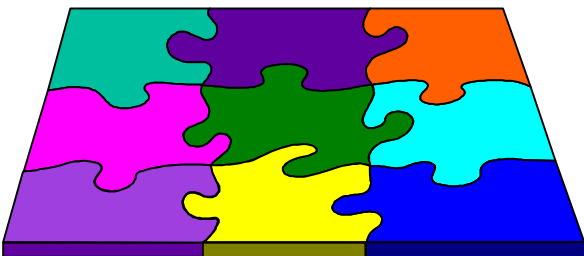
Enjoy the River. Although a major section of the River is seriously polluted, along much of its length the Kalamazoo River is a remarkably wild and natural river. Exert the necessary caution, but enjoy its many facets.

- Take a canoe trip on the River.
- Go catch and release fishing.
- Have a picnic at a city, township, county, or state park.
- Go camping at a state park, county park, or private campground.
- Enjoy a leisurely walk along city waterfronts and nature trails.
- Study the plants and animals of the River and watershed.
- Go boating on the River.
- Go waterfowl hunting.
- Just sit and enjoy the view.



If you are concerned about the stewardship of the River, *take action*. Here are just a few ways.

- Participate in Public Advisory Committee activities. Meetings are held monthly. Several committees are working on specific projects. Call 616-324-1600 for details.
- Join the Kalamazoo River Protection Association or get involved in Kalamazoo River Partners activities.
- Contact your local and state elected officials to express your concerns about the River.
- Educate yourself on the problems and issues, using some of the resources listed in this booklet.



You can help put the puzzle together.

Clean-up and protection of the Kalamazoo River watershed will take all of us. Your piece is vital!

Your efforts will help tame the Beast and enhance the Beauty of our watershed lakes, streams, and the Kalamazoo River. Discover now where your piece fits.